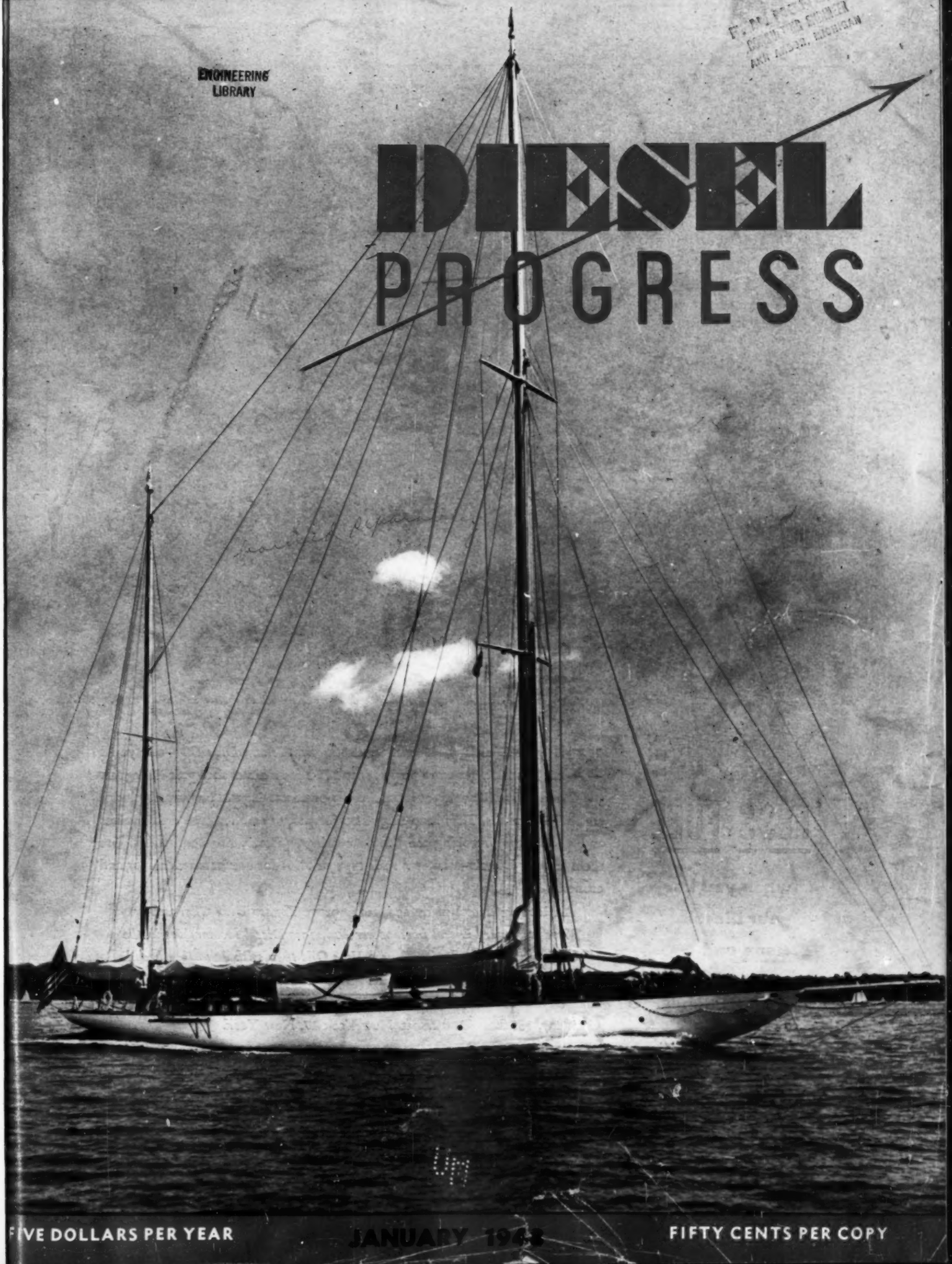
DIESEL PROGRESS



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DIESEL and GAS ENGINE PROGRESS

IN INDUSTRY • IN TRANSPORTATION • ON THE SEA • IN THE AIR

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FRONT COVER ILLUSTRATION: The auxiliary yawl, "Thistle," long prominent in the New York Yacht Club fleet, was recently repowered with a General Motors 71-series Diesel and is now back in service. 102 feet l.o.a. and 74.4 feet at the water line, she is a thing of beauty and speed.

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SOTAVENTO

168-foot Higgins-Built Diesel Yacht for Mexico's President Aleman

Sotavento under full speed ahead, making about 20 knots with the supercharged Enterprise Diesels turning out a total of 2200 hp.

By DOUGLAS SHEARING

THERE have been many fine yachts built in American shipyards since the days when the good people of this hemisphere first began to consider themselves sufficiently well-to-do to begin to spend a little money on diversion instead of laying it all away against the probable coming of a rainy day or a hard winter. Some of these fine yachts were sailing craft which not only gave comfort and fun to their owners but also won and kept on winning cups galore, regardless of the efforts of men like Lipton. Other yachts were built for steam power, some little ones eventually had those tricky little naphtha engines; others tried gasoline motors and finally the Diesels came into the picture, bulky and weighty at first, then gradually becoming lighter and stronger and with a higher ratio of horsepower to engine weight. Supercharging finally has said just about the last word in extracting unsuspected horsepower from Diesels—especially the larger ones—without adding appreciably to the weight of the engine.

Now there is open to prospective owners of big, fine yachts the possibility of installing more than double the power at the same engine weights of the Diesels of just a few years ago, giving fleetness and added seaworthiness and greatly increased maneuverability to hulls which with the older atmospheric pressure Diesels would have been lucky to log ten knots. Supercharging the Diesel has in fact revolutionized yacht performance and construction in the United States.

As in the *Sotavento,* for instance, probably the largest and certainly the finest steel yacht built in this country since the ruinous stock market crash days of '29. Here is an all-welded steel hull, designed and built with sufficient weight and strength of metal to endure any seas anywhere, yet formed for fast, smooth yacht performance because the designers knew that 1800 and more real horsepower could be expected from the same engine weight that about ten years ago would have produced possibly 800. And instead of a ten or 12 knot speed, this magnificent vessel materially exceeded her stipulated 17 knots on her trials, which is fast going for a 168 ft. steel boat.

Sotavento is 168 ft. in overall length, with a beam of 28 ft., a depth of hull of 16 ft. 6 in., and a draft of 10 ft. 6 in., and she is a gift. Fact!

The man who placed the order and paid the bill —over $800,000 it is understood—is said to be one of Mexico's best known financially able citizens, and he has placed *Sotavento* at the disposal of His Excellency Sr. Miguel Aleman, President of the Republic of Mexico; and the ship is now manned by officers and men of the Mexican navy, turned over to them at the commissioning ceremonies on November 19, 1947. The initial trip was from New Orleans via the Panama Canal to Acapulco, Mexico; quite a voyage, but it might as well have been around the world and could have been, for with a 24,000 gallon fuel capacity and 15,000 gallons of fresh water, this big yacht has a cruising range of 4,000 miles.

Higgins, Inc., New Orleans, designed the craft and built it at the Higgins plant on the Industrial Canal, the waterway connecting Lake Pontchartrain with the Mississippi. From this big plant an endless stream of big and little boats went to the armed forces during the war, but it is doubtful if anything more seaworthy than *Sotavento* ever

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Corner of cocktail-lounge-bar room which was designed by Martin-Parry of New York.

hailed from the Port of Higgins. And according to A. J. Higgins, Sr., president of the firm, credit for the creation of the vessel and its construction should be given to H. E. Breit, naval architect of the designing staff, George O. Huet, chief, engineering department, and A. J. Higgins, Jr., vice-president of the firm and plant manager.

Sotavento is a twin-screw vessel and her engines are two Enterprise Diesels, Model DMG-38, supercharged, using Elliott Buchi system turbochargers, and developing 900 hp. each at the comparatively low engine speed of 450 rpm. The engines are of 8 cylinders, of 12 in. bore and 15 in. stroke, and are true right and left hand, turning outboard.

Fuel injection is Bendix-Scintilla, with an individual pump for each cylinder. Winslow fuel filters equip each engine, and another feature is a larger lube oil cooler than conventionally installed with engines of this size, as the use of cast-iron oil-cooled pistons needs more cooling lube oil. The turbochargers on these engines are mounted on the forward ends, an Enterprise design which shortens the exhaust outlet piping; desirable particularly in this instance as the stack is directly over the forward ends of the Diesels.

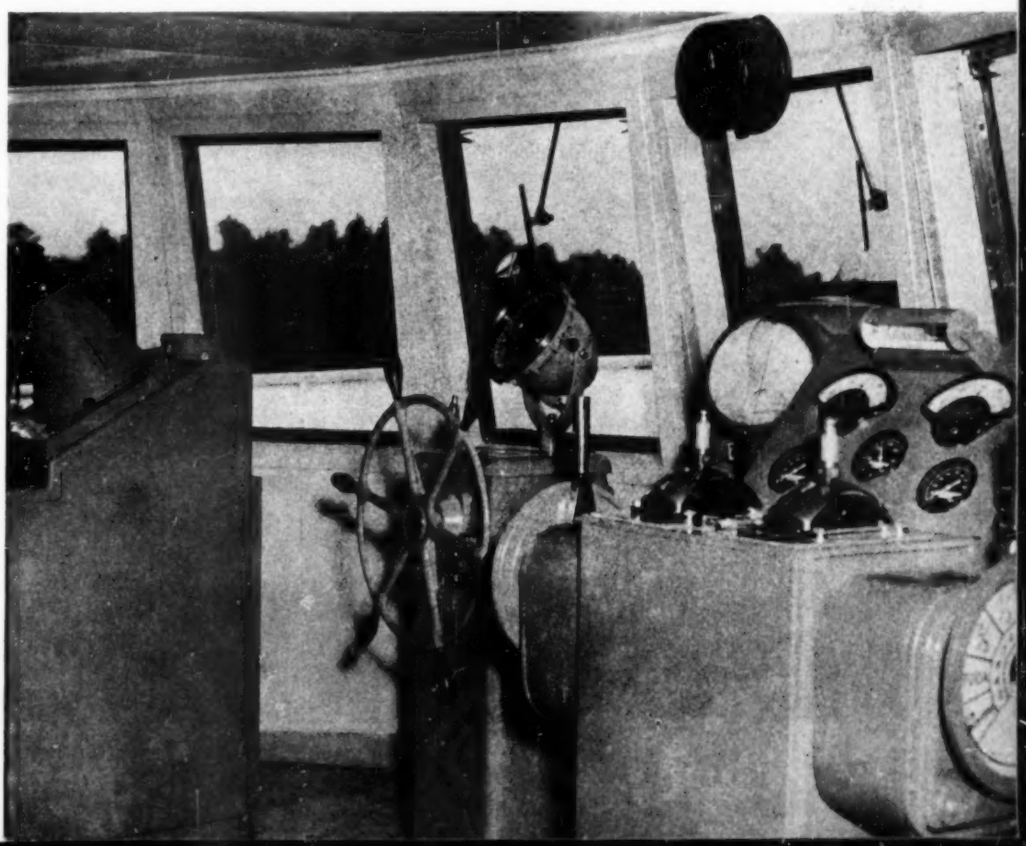
The pyrometer system is Alnor, with the master gauge mounted on the instrument panel forward of the two engines, and with 13 thermocouples for each engine: 8 on the cylinders, 4 on the 4 ports entering the turbine, and one for registering the temperature of the gases after leaving the turbine. Tachometer is Weston. Westinghouse Air Brake controls are installed, with identical controls in both engine room and pilot house, so that by this pneumatic system the pilot house personnel may start, stop or control the main engines. Each engine also may be operated separately at the engineer's stand using the standard Enterprise controls.

Starting and reversing is by air, with the Enterprise air-ram type of reversing mechanism; each engine has a D-330 Quincy air compressor V-belt driven off the flywheel.

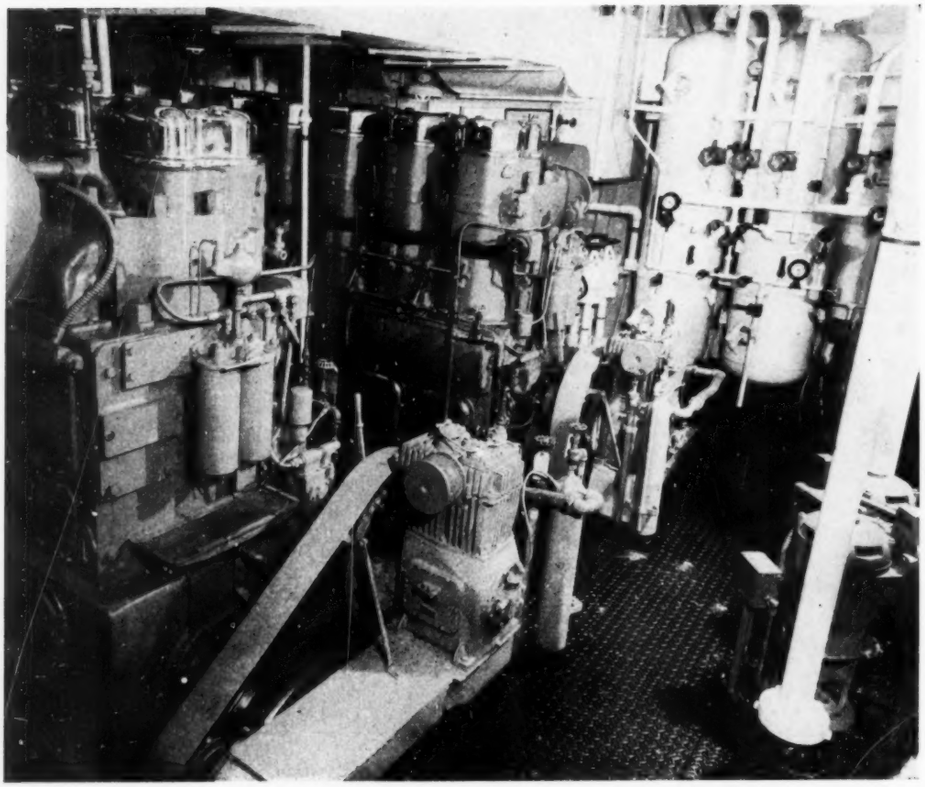
These engines present a beautiful appearance in the engine room; for one angle, there is ample room and good lighting to show them off to advantage and the gleaming, highly-polished aluminum valve covers and crankcase inspection doors add a decided touch of elegance. In this installation, the engines are not level but are inclined slightly, and another instantly noticed feature of this installation is that the engine room floor—of non-skid steel—is laid over the drive shafts, about at a level with the top of the flywheel. This makes it easier on the engineer's gang; valve covers may be removed without resorting to ladders, and one cannot help wondering why this higher floor level is not worked into more engine rooms as it appears practical in the extreme.

Sale of the Enterprise Diesels was handled through Enterprise Engines, Inc., the New Orleans branch of the Enterprise Engine & Foundry Co., under management of Paul Wabnig. Mr. Wabnig closely supervised the installations, was on hand for sea trials and instructed the Mexican navy engineer personnel in the handling and maintenance of the Diesels. "And incidentally," says he, "on the trials at full speed, we took 2200 hp. out of those engines at 450 rpm. without a bit of trouble whatever!"

Auxiliary engines are 3 General Motors 6-71 Diesels direct connected to Crocker-Wheeler generators, 75 kw., 3 phase, 440 volt, 60 cycle, A.C. There is an electrically driven Quincy air compressor, a Viking fire pump, with a bilge pump cross-connected. Electricity is also supplied for two sewage tanks and pumps, a sanitary fresh water pressure unit, a drinking water pressure



Pilot house; Westinghouse Air Brake controls; RMC radar set at left, Sperry steering and Gyro, center.



Aft end of Enterprise diesels, looking from port to starboard. Quincy compressors V-belt driven from flywheels. Note height of engine-room flooring. Air tanks at right rear. Winslow filters on engines.

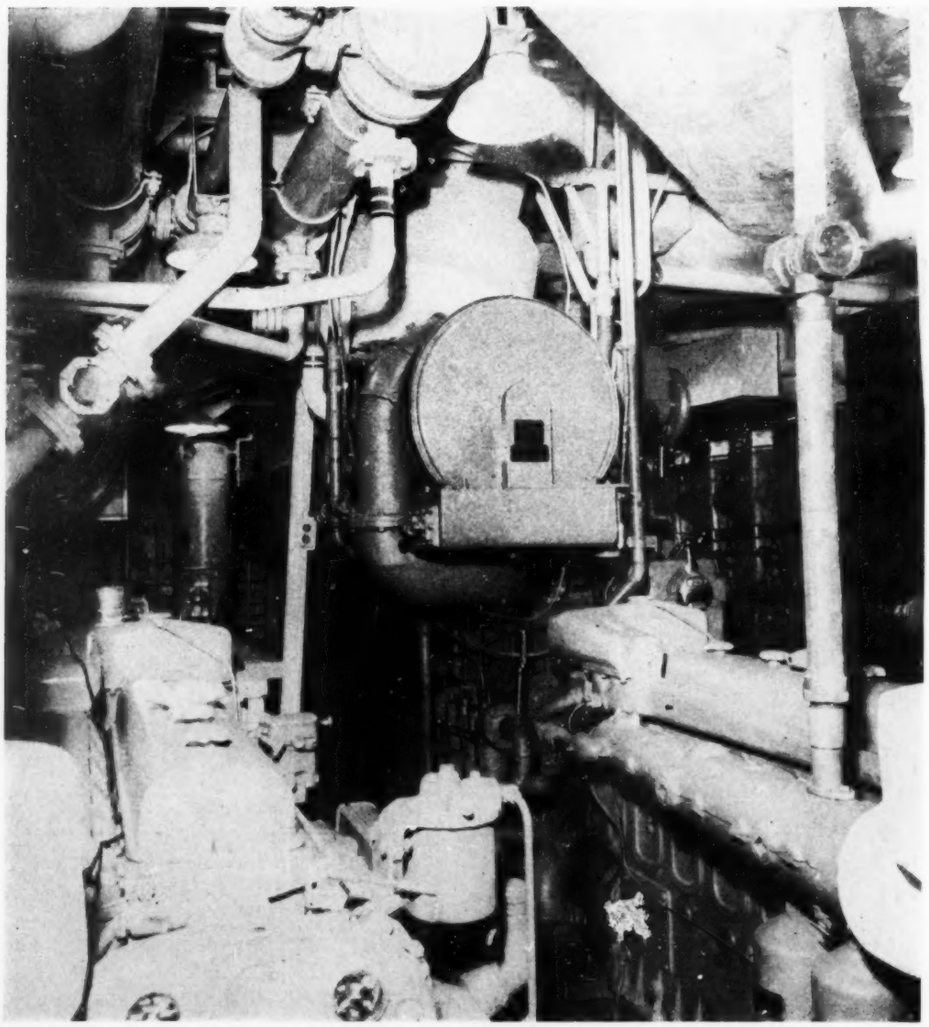
unit with 2 pumps and a fuel oil transfer pump. Other electrical uses are the Bendix automatic laundry and dryer in the ship's laundry, the General Electric Hot Point range in the galley, the G-E toasters and coffee urns, the walk-in refrigerator complete with Dole plates and another electric refrigerator just aft of the dining room. Pilot house electrical requirements are for the Radio Marine Corporation radar set with gyro repeater, the RMC loran unit for locating the ship's position up to 1400 miles from shore, the Bendix depth recorder, the Sperry gyroscope, the Sperry rudder indicator, the RMA direction finder and of course the radio room's Westinghouse radio transmitter and radio telephone. The radio broadcast receiver is a product of National Radio Co., with three radios adjusted to operated on a common antenna. The Sperry gyroscope incidentally has a course recorder tie-in with steering engine for automatic steering.

Accommodations include the roomy owner's stateroom, extending across the entire width of the vessel under the quarter deck, furnished with 2 double beds, built-in wardrobes, a ladies' dressing table and a gentlemen's bureau; a private bath is attached; seven double staterooms and six baths, all completely air-conditioned, serve the owner's party of fourteen.

Deckhouse arrangement features a spacious dining room in a sunken house forward, and a roomy lounging salon aft, complete with a bar as fancy as a swanky hotel cocktail lounge. The interior decoration is strikingly beautiful and was supervised in detail by Mrs. A. J. Higgins, Sr.; furniture was especially designed and built by Martin-Parry, New York for the *Sotavento*.

Along with the perfect decoration, an unusually effective job of sound-proofing was done on this finest of yachts. The engine room even at full speed of the engines is remarkably quiet, with none of the clang and clatter common to most steel vessels. On the afterdeck, directly over the propellers, there is hardly no cavitation rumble except when engines are thrown from full ahead to full astern; there is no perceptible vibration. In the staterooms and accommodations below decks, even when under way one has trouble in realizing that this is aboard ship and not in some unusually quiet hotel apartment.

Yet with all this luxury and modern convenience, this is still a boat, make no mistake about that. Decks are wide, well sheltered; there is strength everywhere, even in the jackstaff and flagstaff.

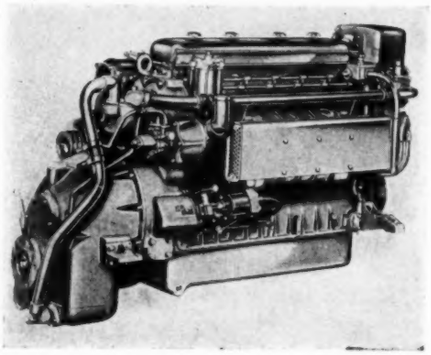


The Elliott turbocharger on the forward end of the starboard engine. In foreground, 2 of the 3 General Motors 6-71 Diesels turning Crocker-Wheeler generators. Upper left, lube oil cooler and heat exchanger for cooling water.

EXHIBITS AT MOTOR BOAT SHOW

AMONG the exhibits at the Motorboat Show will be several new developments in application which have been introduced during the past year. Boat owners and prospective owners will be interested to note some of these.

GENERAL MOTORS Detroit Diesel Engine Division will show a variety of models designed for propulsion and auxiliary power ranging from 60 to 400 shaft hp. New this year is the introduction of 1:1 gear ratio models in 3, 4, and 6 cylinder sizes. In addition, the enlargement of intake ports in the 1948 engines has made possible better scavenging and reduced fuel consumption. With the exception of the 2-cylinder auxiliary models, all engines are equipped with the hydraulically operated reverse gears which cut down conventional gear box space considerably.

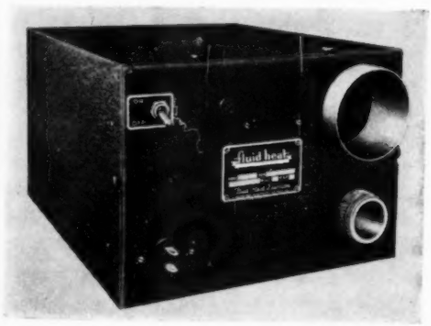


6-cylinder 200 hp. General Motors Series 71 Marine Diesel engine equipped with hydraulic gear.

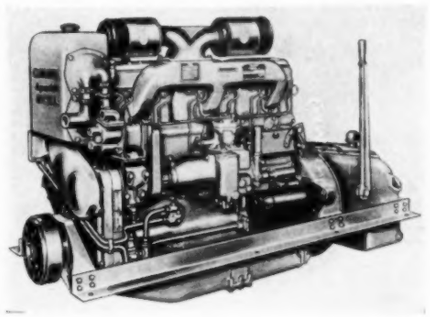
A matched pair of 200 hp. Diesels arranged for twin screw propulsion will also be shown. Engines have opposite rotations and are so mounted that principal accessories are fitted to the inboard side of each engine making servicing easier. In addition there will be a twin six Diesel on exhibit which develops 400 hp. through a single shaft, as well as an 800 hp. twin eight. A 60 and 20 kw. generator round out the exhiibt.

INTRODUCED LAST YEAR Anchor Post Product's Fluid Heat Marine Cabin Heater made many converts at the '47 Show. This year the Fluid Heat Division will present a complete line of heaters ranging from the 15,000 Btu. size for cabin heating to the 70,000 Btu. size for stand-by engine heating, domestic hot water and a combination hot water heating system. These units burn gasoline, kerosene or Diesel fuel and will operate on 6, 12 or 32 volt DC current.

Fluid Heat Marine Cabin Heater



THE CUMMINS ENGINE COMPANY will show several models of its Marine Diesel line including



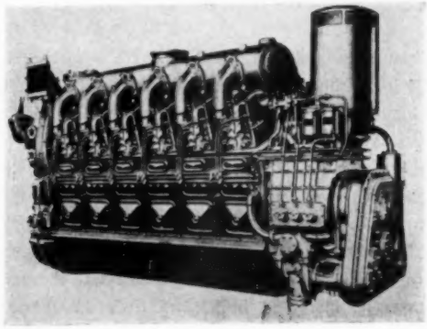
Model NHM-600 Cummins Marine Diesel has maximum rating of 200 hp. at 2100 rpm.

the supercharged Model NHM-600, with a rating of 132 hp. at 1800 rpm. for continuous duty it will be equipped with a Twin Disc reverse and reduction gear. The other model shown will be the LM-600, a six cylinder Diesel rated for marine service at 177 hp. at 800 rpm. This engine has a maximum rating of 250 hp. at 1000 rpm.

Of interest to visitors of the Cummins exhibit will be an actuated cutaway model of a Cummins Diesel which will show actual motion of pistons, valves and other moving parts.

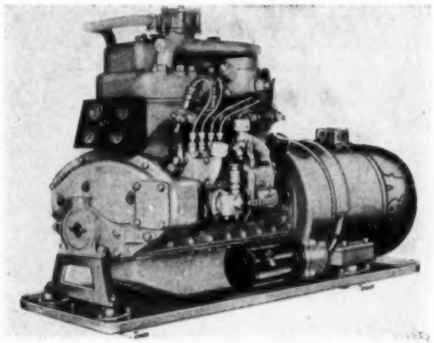
CLEVELAND DIVISION of General Motors will show its 12 cylinder, 1200 hp., model 278A at its exhiibt. This Diesel features the unit fuel injection system and uniflow scavenging. It is available in 6, 8 and 12 cylinder units and can be supplied with direct-connected generators for electric drive or with Airflex clutch and Reverse Gear.

12 cylinder, 1200 hp. Cleveland Diesel



LATHROP ENGINE COMPANY will show its line of marine engines and will include its Type D-60 Diesel, a four cylinder, four cycle marine engine fitted with aluminum pistons and a mechanical governor. This type Diesel is becoming increasingly popular in the work boat field.

UNITED STATES MOTORS CORPORATION will have in its exhibit a new 10 kw. Diesel generating set for shipboard auxiliary use. Driven by a 22 hp. 1200 rpm. Diesel the set weighs 1300 lbs. In addition, the company will show several smaller gasoline driven generating sets.

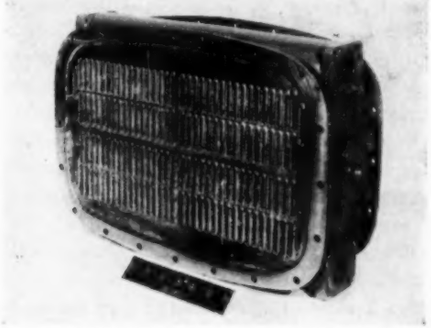


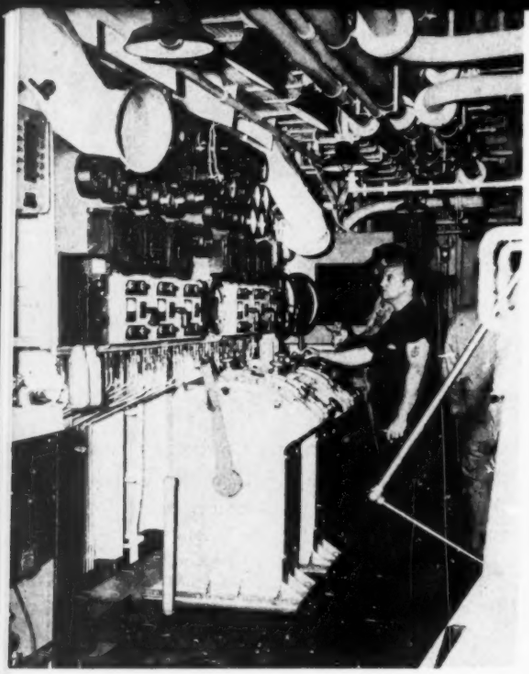
10 kw. Marine Diesel-electric set to be shown by U. S. Motors Corporation.

CUTLESS RUBBER BEARINGS will be featured in the exhibit of Lucian Q. Moffitt, Inc., a synthetic rubber compound, Ameripol, which is said to be oil and heat resistant, is now being used by the Goodrich firm making these bearings.

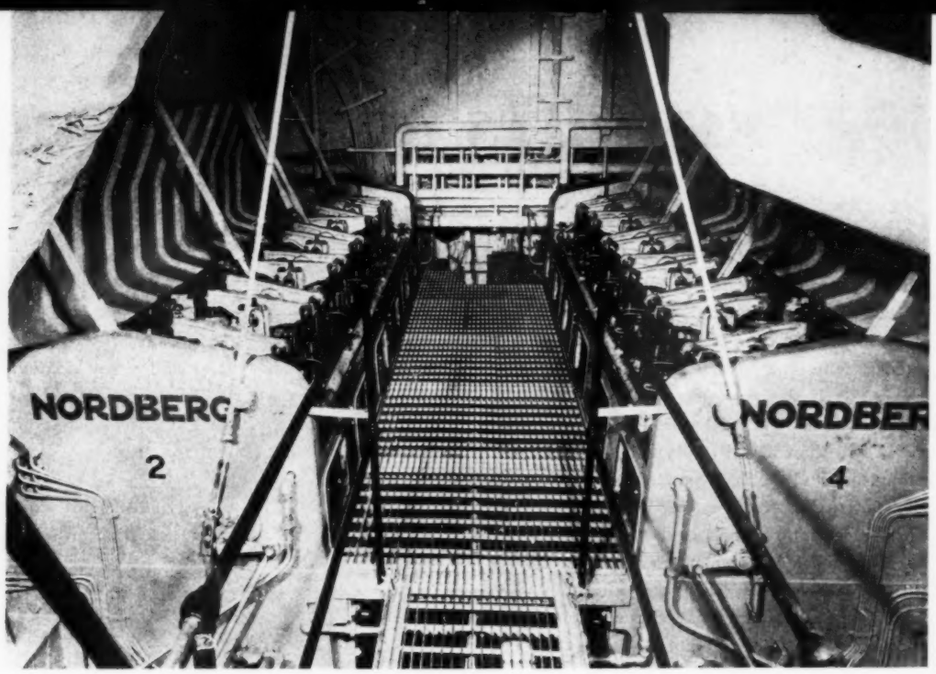
LATEST DEVELOPMENTS in heat exchanging equipment for marine engines will be featured at the Harrison Radiator Division booth. This exhibit will feature a supercharger aftercooler, a new development designed to reduce the temperature of intake air after it has been supercharged. Also a new line of oil and water coolers will be shown which will introduce fabricated metal housings instead of cast housings as previously were used for cooling equipment. A wide range of coolers is now being manufactured.

Harrison Model 1260 plate type oil cooler.





Two control stands located forward in Engine Room. Each control operation of three Nordberg Diesels.



Looking forward over tops of port engines. Six of these 1,200 hp. Nordberg Diesels give vessels a top speed of over 17 knots. They are six cylinder, four cycle with a 16-inch bore and a 22-inch stroke, supercharged.

American-Built French Ships Feature Compact Diesel Installations

By CLAYTON R. SLAWTER

LATEST Paris fashions in naval architecture were shown at the Tampa Shipbuilding Company, Tampa, Florida, with the launching on August 21 of the French ship *Amienois*. Thunder and lightning provided an impressive accompaniment to the stirring strains of the Marseillaise as the smart new vessel slipped off the ways and made a graceful curtsey to the launching party. *M. S. Amienois* is one of a group of six ships contracted for by the French Supply Council in the United States with the Tampa Shipbuilding Company, as a step in the rehabilitation of the French merchant marine. Construction of these vessels is in line with the policy of making that country's new cargo fleet almost entirely of fast motorships.

The design for these six sister ships was prepared by M. le Reverend, Technical Manager for the Societe Anonyme de Gerance et d'Armament, or more briefly, S.A.G.A. Her design was worked out in such detail, including towed and self-propelled model tests, that preparations for her construction were begun as soon as the war ended. Contract plans and specifications were prepared by the Paris firm of naval Architects known as F.E.R.M.I., under the direction of M. Kervarec.

Of necessity, the contract plans were drawn up to Bureau Veritas rules, in the metric system, and to French standard of construction and equipment. On the basis of building to Bureau Veritas rules for full construction, but substituting American standards and equivalent American equipment, the contract for these six ships was awarded to the Tampa Shipbuilding Company.

Principal characteristics of the ships are as follows:

Length overall	371 ft. 10 9/16 inch
Breadth molded	59 ft. 1⅝ inch
Depth	29 ft. 2⅜ inch
Draft	19 ft. 1⅛ inch
Deadweight	3.770 tons
Cargo capacity, grain	251,000 cubic feet
Crusing radius	4,500 miles

The ships are twin-screw shelter deckers, with raked stems, modified cruiser sterns, midships houses, and machinery aft. They are fitted with 7,200 horsepower in Diesel engines. They are of all welded construction except that frames and gunnel bars are riveted to the shell plating and gunnel bars are also riveted to stringer plates.

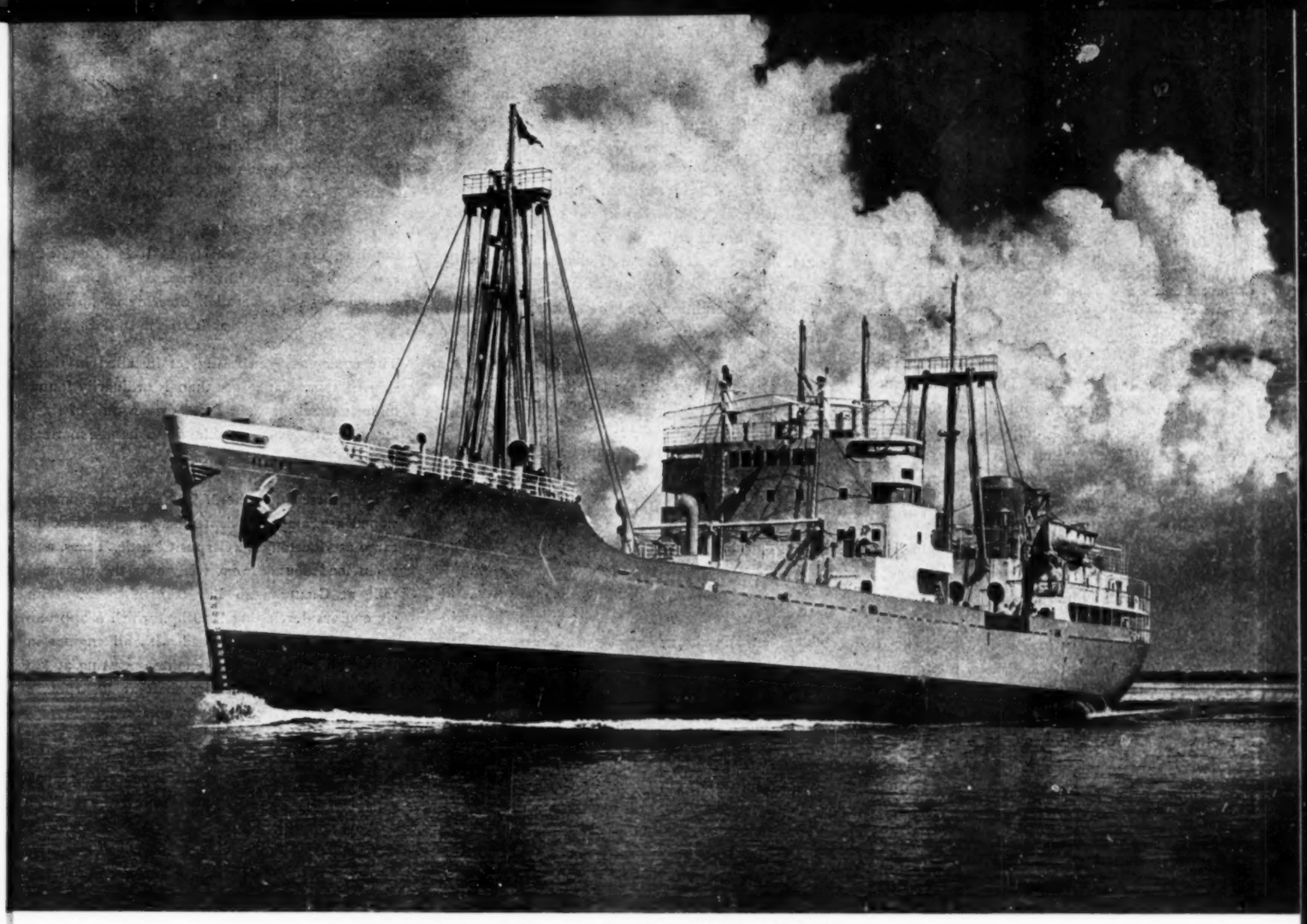
Frames are spaced 27-5/32 in., with a spacing of 24 in. at the ends. An inspection of the lines and characteristics of these ships gives the impression that high speed was a primary consideration in their planning. This impression is correct, although there is no speed stipulation or guarantee in the contract, which merely requires a guarantee of power. That the vessels will have an unusual turn of speed is evidenced by their relatively small tonnage, fine-lined hulls, and their 7,200 hp.

The shapely hulls of these smart short-sea traders are divided transversely into fore peak, Nos. 1, 2, 3 and 4 holds, machinery space, and after peak. A continuous double bottom is provided, with a duct keel on the center line in the way of Nos. 2 3, and 4 holds. Main and shelter decks extend the full length of the ships. Above the shelter deck there is an extended forecastle, a midship house, and a long poop.

On the shelter deck forward in the way of No. 1 hatch there are strong rooms, emergency generator room, CO_2 cylinder room, paint and lamp lockers, and a winch-resistor room. Four refrigerated cargo boxes with a total capacity of 11,300 cubic feet are located on the shelter deck.

The ships will carry a total complement of thirty-four crew members and twelve passengers. Unusually commodious quarters are provided for all hands, with separate single-bed rooms for each member of the crew—an unusual innovation for ships of this type and class. Berthing spaces for both passengers and crew have natural ventilation, augmented by electric fans, and hot-water heating. Interior sanitary spaces are equipped with mechanical ventilation.

Quarters for deck officers and an owner's suite



Diesel ship *Algerie* on trial run. She is one of six sisterships built for France.

are provided on three decks of the midship house. Above these are the wheel house and lower and flying bridges. On the poop are accommodations for engineers, officers' recreation rooms, and passenger spaces. The latter deserve more than passing notice by the reader.

Most cargo ships do little more than provide sleeping quarters for such passengers as they may carry. Passengers are berthed separately, of course, but they mess with the ship's officers and have no deck space of their own. In *M.S. Amienois,* however, they are provided with a light, airy, well-decorated dining saloon, and a bar and cocktail lounge. The poop and boat decks, which are planked, are also reserved for their exclusive use.

One of the most interesting features of these unique ships is the arrangement of their propelling machinery. The two shafts are fitted with three engines each, driving through electric couplings and reduction gears. Two engines of each propulsion unit are reversible, while the third operates in the ahead direction only. The engines are Nordberg six-cylinder, four-cycle, supercharged Diesels. They are of sixteen inches bore and twenty-two inches stroke, developing 1200 brake horsepower at 320 rpm., which would result in 1158 shaft horsepower at 200 rpm. of the propeller.

The non-reversible engine of each propelling set has a dual function. It may be de-clutched from the reduction gear and connected to a 600 kw. generator. When it is desired to operate the ship at full power in the ahead direction the generator is disconnected and the engine becomes a propelling unit. This arrangement permits either one of two main engines to be employed as generator engines in port when working cargo and eliminates the necessity for auxiliary generator sets usually found in more conventional motorships. The system of controls devised by Nordberg engineers for handling this unique propelling installation is worthy of more than passing attention. Amidships, against the forward engine-room bulkhead are two control stands, one for each group of engines installed.

Each stand combines direct controls for two maneuvering engines with switches and levers for three electric couplings. The generator engines are operated by local controls on the engines.

When working as propelling units, these engines are coupled to the propulsion system through the medium of their electric couplings, which are operated from the central control stand forward.

The basic feature of the installation is that any one engine or all six may be idled under no load and clutched or declutched to or from the propeller shafts. To take care of such widely varying load conditions all six engines are fitted with Woodward idling and overspeed governors especially developed in collaboration with Nordberg engineers for such drives. When an engine is started under no load, it is, therefore, idled under automatic governor control at 150 rpm. After the load has been picked up by the electric couplings, however, its control and speed regulation is entirely mechanical.

The propelling machinery installed in *Amenois* and her sister ships affords a wide variety of operating combinations. These are,

a. Both main maneuvering engines, of the port or starboard groups, coupled to their respective shafts and running in the ahead or astern direction.
b. One main maneuvering engine only coupled to either propeller shaft, working ahead or astern.
c. Both engines of either the port or starboard groups idling in opposite directions of rotation making possible a quick reversal of propeller shaft rotation.
d. Both main propelling groups running in the ahead direction, with couplings energized and

combined generating and propelling engines also coupled to the propeller shafts.

e. Emergency stop and reverse.

These operating combinations are made through the control stands mentioned above. Each stand is fitted with two latched levers, one for each of the two maneuvering engines of its group. These levers can be worked individually, as may be required by conditions (b) and (c) mentioned above, or they may be clutched together for operating conditions (a) and (b). A knobbed lever on the control stand actuates the clutch which connects or disconnects the two control levers. Another knobbed lever makes it impossible to move the engine control lever directly from the stop position into the fuel range on its quadrant without pausing in the start position. Another knobbed lever operates the electric couplings of the maneuvering engines, while a fourth one is provided for operating the coupling which connects the combination engine to the propelling system.

Assuming that it is intended to operate two maneuvering engines on one shaft in either direction, the control levers are clutched together and the engines started, with one lever working both units. The clutch between the two engine control levers is connected to a clutch control switch which is closed only when the clutch is engaged. This insures that both couplings of two maneuvering engines of one group can only be energized simultaneously when those two engines are being operated as a single unit by means of one lever.

With the engine idling under governor control, the coupling lever is moved in the same direction as the engine control lever. When two engines of the same group are idling in opposite directions, either may be instantly connected to its propeller shaft by energizing its coupling. Under such operating conditions, it is mechanically impossible to energize both couplings.

It should also be noted that an engine control lever, if moved to the stop position automatically de-energizes the electric coupling of that engine. Should one of the combination engines be required for propulsion, it is started, with its governor set ten to fifteen rpm. above the speed of the maneuvering engines. Its handwheel is then set to the same fuel position as control levers of the other engines. Its coupling lever is then moved to the ahead position, connecting the engine to the propelling system. When working one of these units as a generating engine the overspeed latch knob of the governor is depressed and turned and the overspeed knob is set at 320 rpm. With these settings the governor will regulate the engine at the desired speed.

At sea when all six engines are employed for propelling the ship, electric current is furnished by a 250 kw. turbo-generator set, steam for which is supplied by an automatic waste-heat-oil-fired boiler. This unit is of the forced circulating type, supplying superheated steam at 171 pounds per square inch pressure and 617 degrees Fahrenheit. Auxiliary steam for feed pumps, oil heaters, feedwater heaters, and evaporators is supplied through a desuperheater in the steam drum. The waste-heat elements of this boiler will normally supply steam requirements of the vessels when underway at full power. The oil-fired element will cut in through the medium of an automatic pilot should operating conditions require additional boiler power at any time.

There are two motor-driven fuel-oil transfer pumps and two fuel-oil centrifuges. There are lubricating oil filters and strainers for each main engine, although engine lube oil can be centrifuged by means of a cross connection to the fuel-oil centrifuges.

Through the medium of bilge pump and bilge and ballast pump, the usual drainage and ballasting operations can be conducted. There is also a fire pump and a general service pump. At main deck level in the machinery space there is a machine shop containing an eighteen nich by seventy inch lathe, a drill press, and a grinder.

While *M.S. Amienois* and her sisters were designed for a trade in which cargo is generally worked by shoreside cranes, they have been fitted with complete cargo-handling gear of their own. There are ten eight-ton cargo booms, each with its own electric winch.

Navigating equipment, in addition to being extremely complete and above the general installations found in vessels of this class, contains several electronic devices of the latest post-war models. There is a radar set installed.

Another aid to navigation installed in these ships is an underwater sound fathometer with an electronic recording device. In addition to these items there is a gyro-compass with four repeaters, including one on each wing of each bridge.

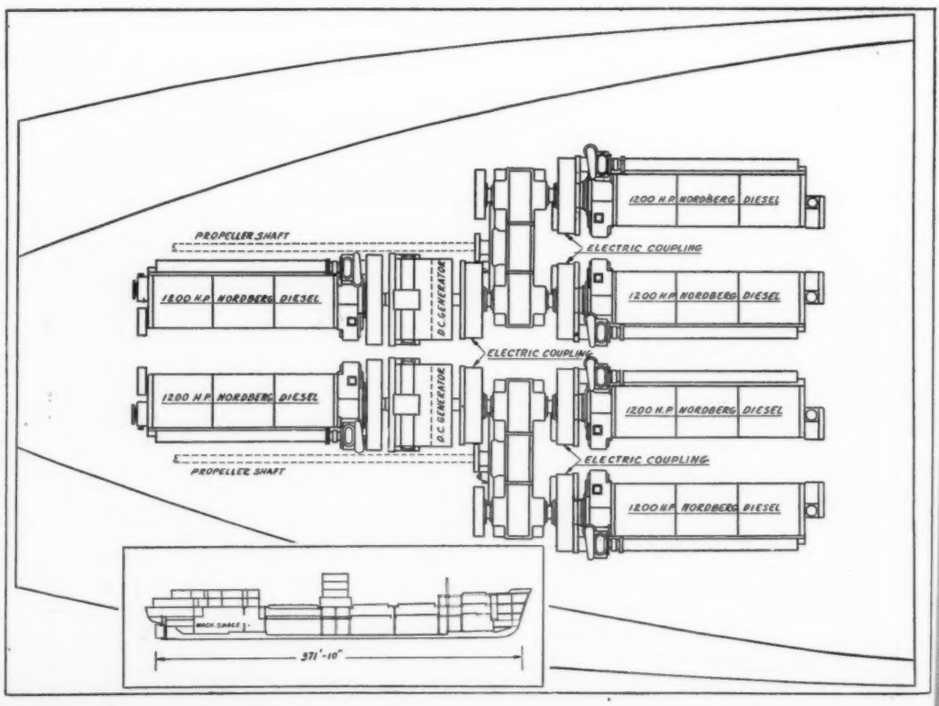
The steering gear is of the electro-hydraulic, Rapson-slide, opposed piston type. It is fitted with two similar power units capable of operation individually or in parallel. Steering is controlled through a telemotor gear from the bridge.

The emergency generating set installed in these ships is somewhat larger than is ordinarily found in such vessels. It is a Diesel-driven unit of sixty kw. capacity, which enables it to handle normal port loads when not working cargo.

One of these ships, the *M.S. Algerie*, was commissioned at Tampa on September 6, 1947, took on cargo at Houston and Corpus Christie, Texas, and when loaded underwent trials over the measured mile at Guantanamo Bay September 23. With six engines developing 7149 hp., which is approximately the normal full load with all engines in operation, and with each engine operating at 318 rpm. turning the propeller shaft at 194 rpm., a ship speed of 17.4 knots was obtained.

At first glance it might appear that the ships have an unusually large electrical generating capacity. The two 600 kw. units, however, have been installed for a very good reason. It is contemplated that at some future date the refrigerated cargo capacity of the vessels will be increased, and it is desired that this can be done without the intsallation of addition generating sets. These ships reflect a great deal of credit on their builder and suppliers who with American equipment matched the original specifications.

Space-saving Diesel installation is unique in ship design.



Diesel towboat *Wm. Pitt*, Dravo-built, develops 1000 hp. hauling coal, sand and gravel for Keystone Division.

NEW TOWBOATS DELIVER 34,000 LB. "PUSH"

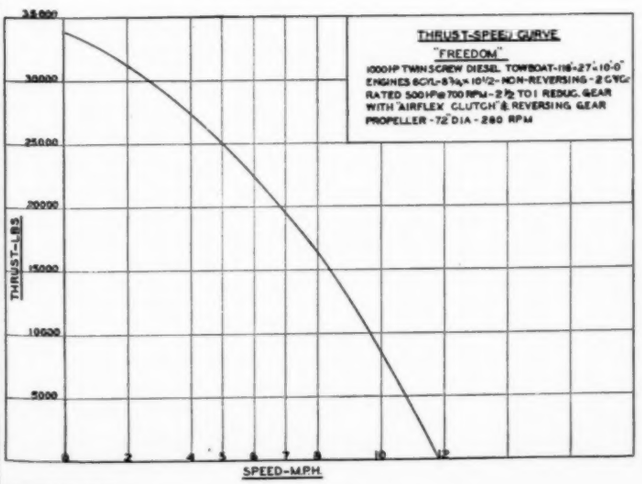
THE *Wm. Pitt* and the *Freedom*, two of the latest Dravo towboats to be put in operation have demonstrated their ability as sterling "pushers." Tests have shown that these vessels have "push power" of 34,000 lbs. against the dock and 25,000 lbs. at a towing speed of five mph.

A combination of factors permit this extra power for the relatively small hulls of the *Wm. Pitt* and the *Freedom:* The utilization of lightweight, high-speed geared Diesels; improved Kort nozzle efficiency and greater draft. Effective thrust of the vessels is increased because of the new hull design which eliminates the necessity of stern tunnels for the Kort nozzles and permits a free flow of water to them and more efficient propulsion.

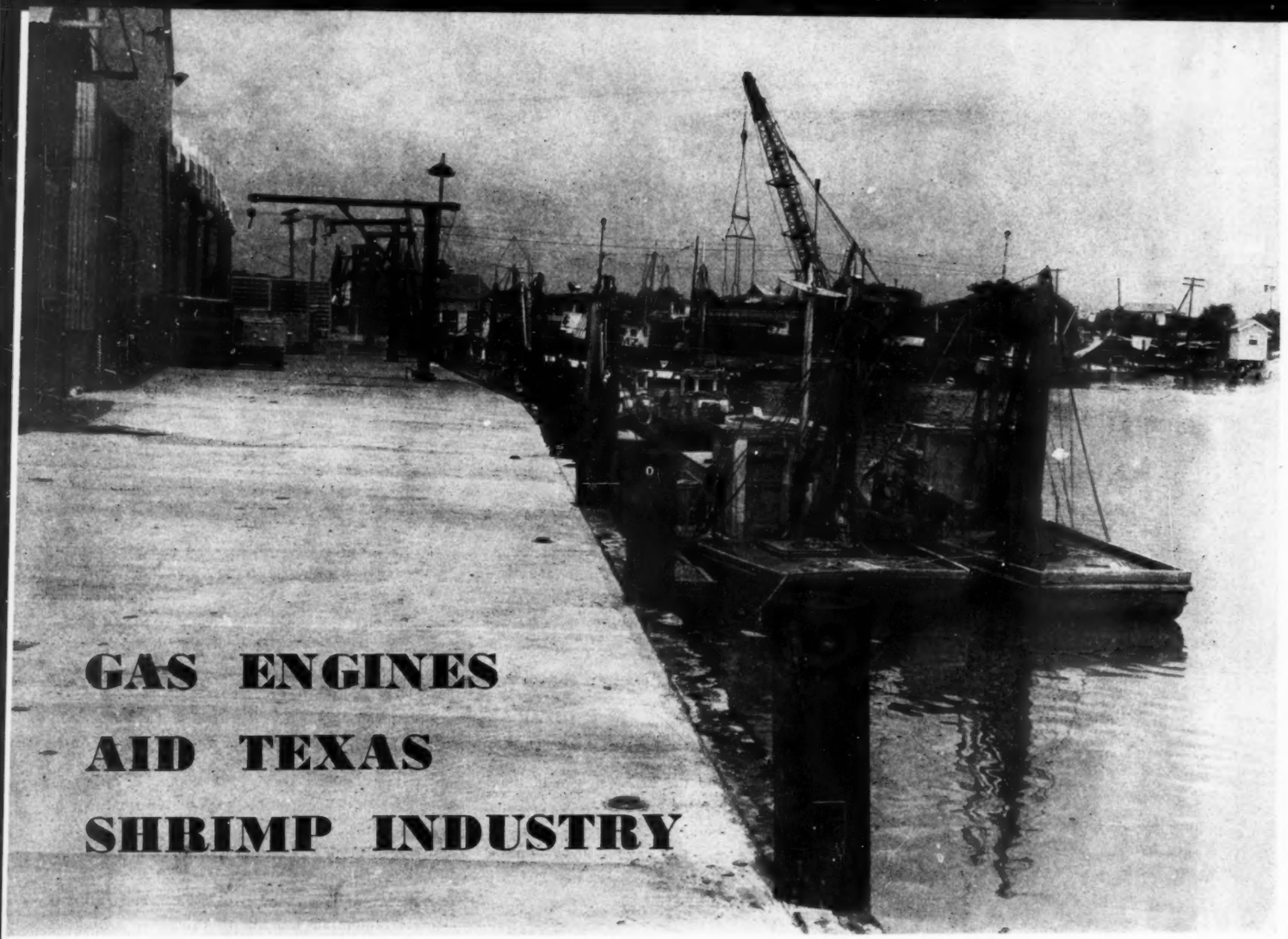
Power for each towboat is supplied by two General Motors supercharged, 6 cylinder, 2 cycle Diesels which deliver 500 hp., each at 700 rpm. to the Falk Airflex reverse and reduction gears. The four bladed propellers turn at 280 rpm. The main engines are equipped with Briggs lube oil clarifiers, Ross jacket water and lube oil coolers, and two General Motors air compressors driven by 5 hp. motors, controlled by magnetic type starter.

Auxiliary power is supplied by 2 General Motors 3 cylinder Diesels driving 30 kw. 120 volt dc generators at 1200 rpm.

Each vessel is 116 ft. long with a 27 ft. beam and 10 ft. moulded depth. Draft with ¾ fuel and supplies is 7 ft. A crew of thirteen operate each vessel. The engines are pilot house controlled.



Two 500 hp. General Motors Diesels power *Wm. Pitt*, they are 6-cyl. 2 cycle engines driving through Falk reverse and reduction gears.



GAS ENGINES AID TEXAS SHRIMP INDUSTRY

By WILL H. FULLERTON

Municipal Dock, at Port Lavaca, equipped for receiving, packing, freezing, cold storage and shipping shrimp.

ALTHOUGH the annual production of shrimp in Texas runs into sizeable figures and heavy money, Texas has no one home port of the industry which can be compared in number of boats and seafood packing and shipping plants to Morgan City, Houma or Golden Meadow in Louisiana, or with Biloxi in Mississippi. Those ports number their big trawlers by the hundreds and their annual production is enormous in a good season; Morgan City and the near-by Berwick Bay communities in Louisiana really have been largely responsible for putting jumbo shrimp in the nation's markets.

Texas has a long coastline; aside from Galveston, its fishing ports are small. And to offset the smaller size of the average Texas boats and smaller production, one city in particular on the Texas waterfront offers something very special to the southern fishing industry, and that is a municipal plant for handling the shrimp brought into this thriving little port.

Port Lavaca is the city. It is an old one, as Texas ports go, from which many years ago in the days before the transcontinental railroads and the Chisholm Trail, cattle were shipped to the New Orleans market in paddle-wheel steamers. Port Lavaca today has a population of only a few thousand, but its Municipal Market and Ice Plant is an institution which could be profitably studied and emulated by every seafood producing center in the South, if not in the whole country.

On the water side, there is a wide concrete dock, over 300 feet in length, at which the trawlers can be moored for discharging cargo; efficient hoists are built-in features. Abutting on this long dock is an almost equally long building, 130 feet in depth, providing space which is leased to the various shrimping firms. Side by side are the heading and packing plants of the Colter Corporation, (owned by Kroger Grocery & Baking Co.); the Western Shell Fish Co., (the Texas end of Southern Shell Fish, of New Orleans, itself controlled by Wesson Oil); F. V. Gentry Co., a local firm; and General Seafoods, (General Foods) whose 40-Fathom trademark on all sorts of seafoods is nationally famous. The building is all concrete construction, can be maintained in a condition of spotless cleanliness, and to the firms leasing space probably fifty trawlers bring their catches. Besides the shrimp brought here in boats, many more are trucked in from Freeport, Arsansas Pass, Rockport and Port Isabel for freezing and holding.

Besides facilities for unloading, heading, packing and shipping fresh shrimp, the layout provides for quick-freezing and cold-storage. The original planning of the facilities far undershot the need; the first storage capacity was for 250,000 lbs. of frozen shrimp. In 1945 a big addition was made, adding 1,000,000 lbs. to the storage capacity. Blast freezers were also installed and the plant could freeze 150,000 lbs. daily. Shrimp after being headed and washed are packed in 5 lb. waxed paper cartons; these are loaded into "buggies," which are tiered racks mounted on small wheels; each buggy has 12 racks and holds, when fully loaded, 1200 lbs. of shrimp. There are 3 freezing tunnels, with a capacity each of 25,000 lbs. of shrimp loaded in buggies. Two loadings daily of the tunnels gives the light catches at present only one tuunel-loading a day is practiced.

Besides the freezing and cold storage, the plant also includes ice manufacture, with a capacity of 27 tons per day. This ice is used for furnishing to trawlers and for shipping fresh shrimp.

All refrigerating equipment is Frick, according to

H. G. Regan, chief engineer, who has been with the plant for nine years, since it was first established.

The refrigerating equipment includes:
One 10 in. by 10 in. compressor, belted to a 155 hp. Atlas Imperial gas engine, using natural gas for fuel; this engine is also belted to a 150 kw. General Electric generator.

One 8 in. by 8 in. compressor, belted to another Atlas gas engine of 150 hp., which also turns a General Electric generator of 75 kw. capacity.

One 11 in. by 10 in. compressor, direct connected to a 185 hp. Bruce-McBeth natural gas engine.

One 17¾ in. by 12 in. booster compressor, driven by a similar Bruce-McBeth engine.

One 11¾ in. by 8 in. booster compressor, belt driven by at 40 hp. electric motor at 400 rpm. These last two compressors provide two-stage refrigeration for quickly freezing.

For providing electric current for blower fans, plant auxiliaries and lights, there is a Cooper-Bessemer 5 cylinder natural gas engine, 375 hp. at 450 rpm., direct connected to a 750 amp. 220 v. Westinghouse generator. Also driven by electricity furnished by this engine is an 8 in. by 8 in. compressor belted to a 60 hp. Century motor, 300 rpm., used for maintaining a zero temperature.

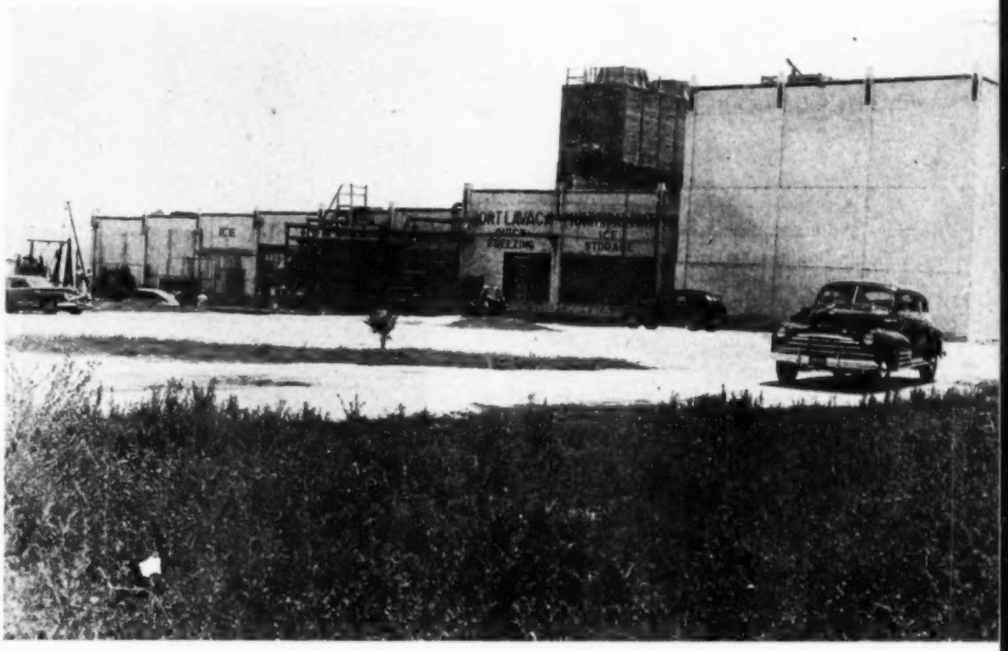
The first gas engines installed were the two made by Atlas, and they demonstrated to the engineers the efficiency of natural gas as a fuel. For one thing, the cost of this fuel is cheap, in Texas. Another important item is the lower compression than Diesel operation, which shows up in maintenance figures. So satisfactory was the all-around performance that when the plant was enlarged, more natural gas engines were specified. Over two hundred thousand dollars were to be spent on this enlargement and Engineer Regan was too well sold on gas operation to consider other fuel.

Mr. Regan makes it plain that the purchase of engines other than the original make installed was due to no complaint about the Atlas machines. "They did a good job and are still doing it," he points out, "but it was war time and we had to buy where we could get deliveries. The added capacity for our plant was imperative, and in such a predicament an engineer is glad to take delivery of any high grade engine. We did insist on standard makes of high-quality engines, but war buying and delivery problems prevented us from standardizing on any one engine, much as we would have liked to do so for parts and maintenance reasons."

The Bruce-McBeth engines, made in Cleveland, Ohio, are big, heavy duty machines, delivering their 185 hp. at only 300 rpm. The natural gas in the mains is between 30 and 35 lbs. pressure; this is reduced to an 8 oz. pressure, then passes to a pressure reducing valve which further reduces it to 2 oz., from which it goes to the mixing valve where air is mixed with the fuel before it goes to the cylinders. Ignition is by American Bosch magneto, using two spark plugs to each cylinder. The engines operate at around 110 lbs. compression. Excellent service is reported from these two Bruce-McBeth engines, both installed about two years ago. Good reports are likewise given the Cooper-Bessemer, which is incidentally equipped with a Honan,Crane lube refiner.

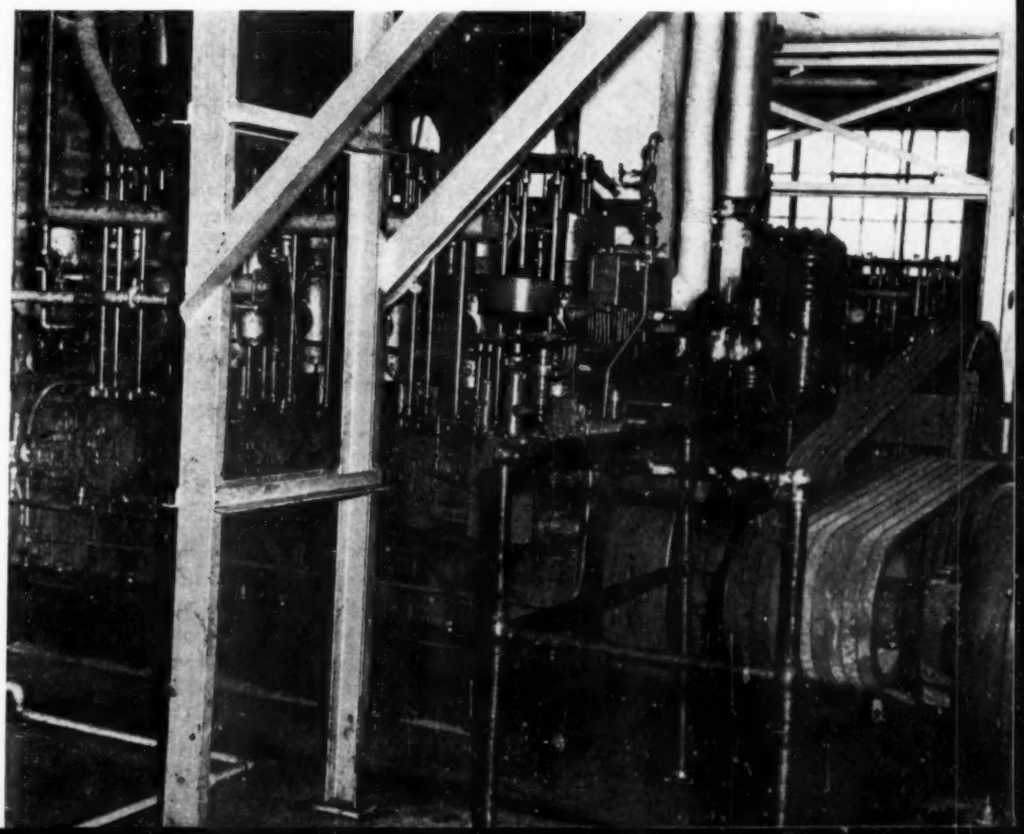
Cooling of all the engines is closed circuit, using a Marley forced draft tower.

This whole plant—location, dockage, processing rooms, ice-making, quick-freezing, cold storage—is a splendid example of what can happen when a city decides to support an industry with excellent engineering. The contrast between Port Lavaca's seafood arrangements and those of the average small fishing community is startling. Here, cleanliness has a chance; from here, high quality seafoods are to be expected.



Above: Landside view of Port Lavaca shrimp plant; new cold storage addition extreme right.

Below: Two Atlas gas engines, seen here, are belted to Frick compressors and G.E. generators.



EUROPEAN MOTORSHIP DEVELOPMENT

PART I

By A. P. CHALKLEY, Editor of "The British Motor Ship"

Editor's Note: We are privileged to present the text of A. P. Chalkley's recent address to the Diesel Engine Panel of the recent Marine Conference held in New York. Speaking under the sponsorship of the Diesel Engine Manufacturers Association, Mr. Chalkley built up an impressive case in favor of the Diesel-propelled ship. His paper will be published in two parts, beginning with this issue.

THE subject of the application of Diesel engines to European ships is too wide to cover in a short talk and therefore I will endeavor to summarize the position by showing the extent to which motor ships are being built, stating the reasons which have influenced owners, and finally, giving a picture of recent European motor ship development with an indication of the lines along which marine men are proceeding.

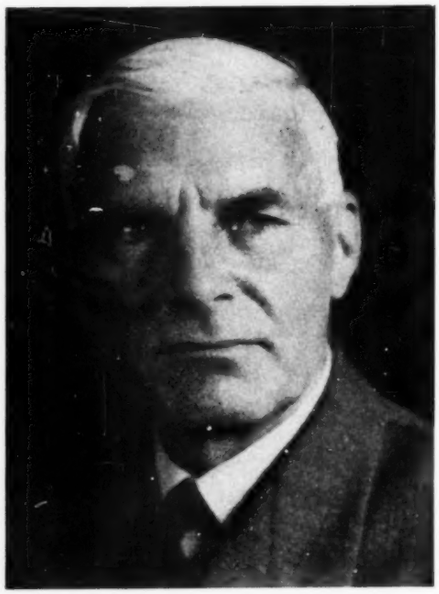
The first ocean-going motor ship, the *Selandia*, was completed in 1912. Today the numbers and tonnage of motor vessels on order in Europe are double those at any previous time, and the proportion of such ships to steamers is much larger. The total is about 700, of 5,750,000 tons deadweight, and the machinery to be installed exceeds 4,000,000 hp., an impressive total.

Taking Europe as a whole (including Great Britain), 65 per cent of the mercantile tonnage now on order will be equipped with oil engines.

In Sweden, Denmark and Holland, the percentage is over 95, and in Great Britain about 60. In Britain, the only present limitation to the building of motor ships is that imposed by the productive capacity of the Diesel engine factories.

Thus, as a result of 35 years' experience, in good times and bad, in peace and in war, European shipowners have turned to the motor ship—on the Continent almost exclusively, and in Britain to a very large extent.

From the first, those shipowners who adopted the Diesel engine relied on the basic fact that it was thermodynamically by far the most efficient prime mover. In employing it, they took the risk that artificial circumstances, such as relative cheapness of boiler oil or coal, would destroy the advantages of the high efficiency engine. Their attitude has, however, been justified, and never more than today, when the most economical use of our fuel resources is a fundamental need if our standard of life is to be maintained.



Mr. A. P. Chalkley

Time and time again, British shipowners were urged to build coal-fired steamers in order to help the coal industry, and in 1938 a subsidy was given to owners who would build coal-fired steamers instead of motor ships. Had that advice been widely followed, Britain's coal situation would have been far worse than it is.

Table I gives details of the motor ships of over 2,000 tons deadweight on order in Europe on September 1, according to published announcements. In addition, there are about 300 ships totalling 4,000,000 tons deadweight, all below 2,000 tons deadweight.

Owing to the congestion in the shipyards, only about half of the ships are laid down, and in Sweden, not more than 25 per cent are already on the stocks. Deliveries for some of the larger ships extend to 1951. The number and tonnages of various classes of motor ships being built are enumerated in Table II.

The construction of motor tankers forms a large section of the European shipbuilding industry. Table III gives particulars of the vessels of this class on order, but less than half are laid down, and it is anticipated that some of the very large vessels will not be completed for another three years at the present rate of construction.

Norway has more motor ships on order than any country, totalling 2,300,000 tons deadweight (in addition to 300,000 tons of steamers), but as Norway's shipbuilding capacity amounts to less than 50,000 tons per annum, the bulk of the contracts had to be placed abroad, largely in Sweden and Great Britain. Shipbuilding has thus become an important export industry in those countries and in Great Britain the "foreign Flag" motor vessels on order total 9,000,000 tons deadweight, while in Sweden, 111 ships of 1,216,000 tons deadweight are to be built for Norway.

In Table IV are given particulars of the merchant ships launched or commenced in Europe for the quarter ended June 30, 1947. These figures give a factual picture of the European shipbuilding posiiton and we may now inquire why there has been this general adoption of the Diesel-engined vessel. Undoubtedly, the main advantage of the motor ship and the chief reason for its employment by European shipowners is the economy in the fuel bill compared with other vessels, allowing for the fact that Diesel oil costs more than that used under boilers.

For propulsion alone, the consumption may be taken at 0.35 lb. per bhp. hr., for a range of output from 60 up to 90 per cent of full continuous rated power, which covers the normal service conditions. In a cargo ship, very little additional fuel consumption has to be debited for auxiliary power because of the employment of Diesel-engined generating plant and electrical machinery. Most modern motor vessels are equipped with exhaust gas boilers and these provide steam for auxiilary services, in some cases sufficient for all auxiliary purposes at sea, in which event the fuel consumption per bhp. of the main engine becomes the total consumption. In large passenger ships where the "hotel" load is heavy, the fuel used is generally in the neighborhood of 0.39 lb. per bhp. hr. for all purposes.

Average fuel consumption of typical European motor ships are shown in Table V. Each vessel is of a class of which a number has been built. The figures are those actually attained in service over a long period, and may be taken as fully representative. They show a very large saving in the fuel bill in comparison with oil-fired steamers on practically all trade routes allowing for the differential between the prices of boiler oil and Diesel oil. See Table V.

Typical voyage results of standard 12,000 ton, 15 knot, motor cargo ships built during the war are given in Table VI. The vessels in question are 475.7 ft. long with a beam of 64.2 ft. and a draught of 29 ft. 6 ins. when fully laden, the machinery power continuous rating being 6,800 bhp. Electricity is provided from two Diesel generating sets of 210 kw. Ships of this class constructed as oil-fired geared turbine steamers have a consumption nearly double that of the motor ship.

In almost all ships, the fuel consumption can be guaranteed to remain constant over years of service, and in some instances, there is a reduction. In fact, it is generally accepted that the dally fuel consumption is slightly lower after six months service than it is at the time of the trial trip, and as regards the complete life of the ship, the *Selandia*, the first motor vessel, was a classic case, since after 20 years' operation, the daily fuel consumption was, if anything, slightly lower than at the time she put to sea.

Apart from the economy of the fuel bill, owners have found in service that the motor ship possesses many ancillary advantages. The amount of fuel used in an oil-fired steam is at least 50 per cent more than in a coresponding motor ship. Consequently the latter has a larger radius of action without rebunkering, or alternatively, carries more cargo. This characteristic is particularly valuable on long-distance routes and the trend towards higher speeds gives it increased importance.

The importance of the human problem in connection with motor ships cannot be too strongly emphasized, and there is no question whatever that such success or failure in their operation depends far more upon the engineering personnel than it does in steamers. This is a matter that those who contemplate operating oil-engined ships for the first time must take into consideration.

The quality of the engine-room staff is, moreover, reflected in the repair bills for the machinery of motor ships perhaps more than in connection with steam plant. When sufficient care is given to this problem, the upkeep, repair and replacement charges of Diesel-engined vessels are no greater than in steamers. As an example of average figures with well-maintained machinery, the following particulars may be given.

With three ships of a class of 9,000 tons deadweight capacity with double-acting Diesel machinery of 9,900 ihp., over a period of 18 months, the cost of repairs was £1540, the spare parts £1250 making a total of £2790 per annum.

In a series of four 9,160-ton ships with 5,400 ihp. single-acting machinery, the repair bill per annum was £850 and the cost of spare parts £660, making a total of £1510 per annum.

There are recent figures based on present-day repair costs and in both cases they represent about 4/6 per ihp. per year, or, say, $1.40. It may be added that the original cost of a European motor ship is rather lower than that of a corresponding oil-fired geared turbine steamer.

A factor which has influenced shipowners in favor of oil engines, particularly those with a large fleet of vessels, is the extent to which machinery standardization can be carried out, even when widely differing powers are required in the ships. In cases where differences of power arise, the same type of engine with variation in cylinder numbers is frequently adopted.

For instance, one British owner, in ordering five cargo ships in which the power ranged from 6,600 to a total of 13,200 bhp. employed standard cylinder sizes for all ships, some twin-screw and the others single-screw, and the engines were built up of 44 precisely similar cylinders, with many of the other parts of the engines standard throughout. A subsidiary advantage is that the company's engineers become very conversant with the operation of a standard type of engine and interchangeabiilty of staff can be carried out with the utmost efficiency. In motor ships, too, in the same fleet, it is usual to adopt standard auxiliary generating engines and here again, if necessary, the number of cylinders may be varied, so that the cylinder size and most of the engine details are standard.

In this connection it is to be noted that most European Diesel engine builders concentrate upon two cylinder sizes, or three, as a maximum, and as a consequence, the number of spare cylinder liners, etc., which they have to carry in order to be able to supply shipowners rapidly, can be reduced.

There are several reasons why steam propulsion has still retained more hold in British shipping than on the continent. The present tonnage being built in Britain includes a fair proportion of passenger liners, with very high-powered machinery, for which most owners prefer oil-fired boilers and geared turbines, even though recognizing that the fuel bill will be higher.

Moreover, steam machinery can, in most instances, be delivered more quickly than Diesel engines because of the very full order books of the Diesel engine manufacturers, and this is of importance in certain cases where owners feel the necessity of building up their fleets with the least possible delay. It is rare, indeed, however, for a British owner to order a ship with oil-fired boilers and geared turbines when under 6,000 bhp. is required.

A new situation is arising in the possibility of the employment of boiler or residual oil in the machinery of Diesel vessels. In August, 1946 a new 12,000 ton motor tanker belonging to the Anglo-Saxon Petroleum Co. was equipped with a standard 4,000 ihp. four-stroke engine modified to run on a grade of fuel which is of a much lower quality than Diesel oil and is considerably cheaper. It has a viscosity of 1470 secs. Redwood 1 at 100 deg. F., a specific gravity of 0.975 (14 A.P.I.), and a sulphur content of 2.5 per cent. After more than 12 months' service the owners state the results have been wholly successful and it would seem that a step forward has been made towards the employment of lower grade fuels in Diesel engines. The means adopted lies mainly in the careful purifying of the fuel by the employment of two centrifugal separators in series and the heating of the oil up to the time of its admission to the cylinders. The fuel consumption is slightly higher than with Diesel oil, but the fuel bill is reduced £5,000 per annum and a year's service shows no appreciable increase in liner wear. The owners do not anticipate a heavier maintenance bill. The additional capital cost involved is such that it is wiped out in about a year's service.

TABLE I

Motor Ships on Order in Europe over 2000 Tons Deadweight

Country	Number	Deadweight Tonnage
Britain	244	2,277,000
Sweden	173	1,576,000
France	53	405,000
Holland	42	381,000
Denmark	59	343,000
Italy	35	230,000
Belgium	25	201,000
Norway	31	128,000
Spain	25	208,000
	699	5,751,000

TABLE II

Types of Motor Ships on Order

Class of Ship	Number	Deadweight Tonnage
Passenger Liners	14	191,000
Tankers	138	2,064,000
Fruit ships	25	82,000
Refrigerated ships	15	210,000
Cargo ships	507	3,195,000
	699	5,742,000

TABLE III

Motor Tankers on Order

Country of Construction	Number	Deadweight Capacity
Britain	59	845,000
Sweden	49	806,700
Denmark	8	118,400
Belgium	5	84,700
Holland	3	40,000
France	5	94,800
Spain	7	74,900
	118	2,064,500

TABLE IV

European Vessels Launched during the Quarter Ended June 30, 1947

Country	Steamers No.	Steamers Gross Tonnage	Motor Ships No.	Motor Ships Gross Tonnage	Total No.	Total Gross Ton
United Kingdom	38	101,905	48	138,324	86	242,229
Rest of Europe	16	17,101	88	171,717	104	209,018
Total	54	141,206	136	310,041	190	451,247

Percentage of Motor Ships Launched

United Kingdom	57
Rest of Europe	88
Total for whole of Europe	72

European Vessels Commenced During the Quarter Ended June 30, 1947

Country	Steamers No.	Steamers Gross Ton.	Motor Ships No.	Motor Ships Gross Ton.	Total No.	Total Gross Ton
United Kingdom	36	81,860	49	189,455	85	271,315
Rest of Europe	6	13,040	79	165,877	85	178,917
Total	42	94,900	128	355,332	170	450,232

Percentage of Motor Ships Commenced

United Kingdom	70
Rest of Europe	93
Total for Whole of Europe	79

TABLE V

Fuel Consumption of Typical European Motor Ships

No. of ships of Class	Deadweight Capacity Tons	Average Speed in Service knots	Tons of Fuel per 24 hrs. All Purposes
6	11,600	15	25-26
20	9,200	13	11
20	12,100 x	104	12.5
2	9,000	15.45	24.5
2	9,160	13.15	14.1

X - Tanker

TABLE VI. FUEL CONSUMPTION OF STEAMSHIP 12,000-TON 15-KNOT MOTOR SHIPS

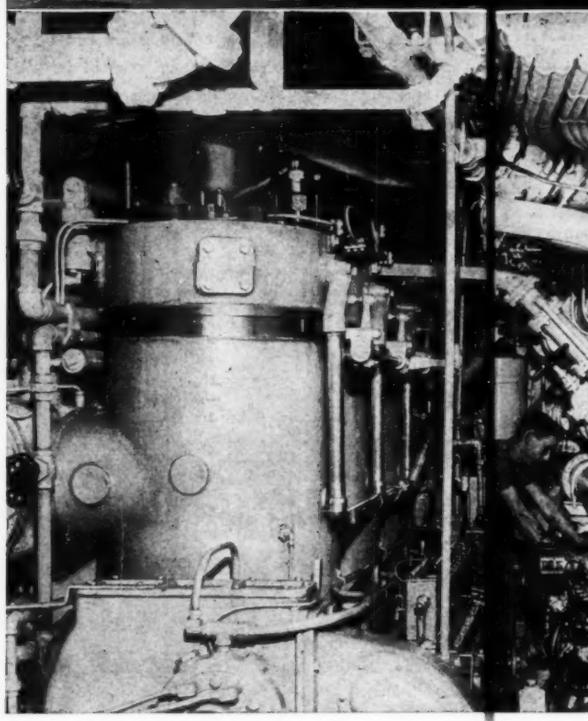
Distance	I.H.P. Service	Speed	Average Draught		Fuel Consumption per day for all purposes	Fuel per I.H.P.hr.	Fuel per B.H.P.hr.
Miles		Knots	Ft.	Ins.	Tons	Pounds	Pounds
3274	7120	14.1	28	6	26.9	.39	.35
2400	6449	14.7	27	7	21.5*	.295	.34*
2748	7340	15.1	25	11	25.	.315	.36
6510	7470	14.5	28	0	24.7	.31	.355

*Propulsion only

Sea-going workhorse *El Sol*, powered by two 690 hp. Fairbanks-Morse Diesels, is owned by Ocean Tow, Inc. Alongside her is seen steel barge used in Alaska freight service.

Below right, Engine room of *Maclofay* showing two Fairbanks-Morse main engines. At right is 6-cylinder Hercules Diesel generating set.

Far right, Giant log tow from British Columbia on its way to Anacortes, Washington. At head end is tug *Teton*.



DIESEL TOWBOATS IN THE PACIFIC NORTHWEST

Ocean Tow Inc. Inaugurates New Towing Services To Alaska and British Columbia with 8 Diesel Tugs

By W. J. GRANBERG

TWO projects, one a new barge line freight service to Alaska and the other a log haul job from Briitsh Columbia waters, are engaging the powerful deep-sea, Diesel-powered tugs of Ocean Tow, Inc., in outstanding towing operations. Most important of the two, although perhaps not the most colorful, is the Alaska run for which the newly-organized Alaska Freight Express Corporation is leasing tugs to tow giant steel barges to Seward, port and railhead, in a new shipping service which was inaugurated in November.

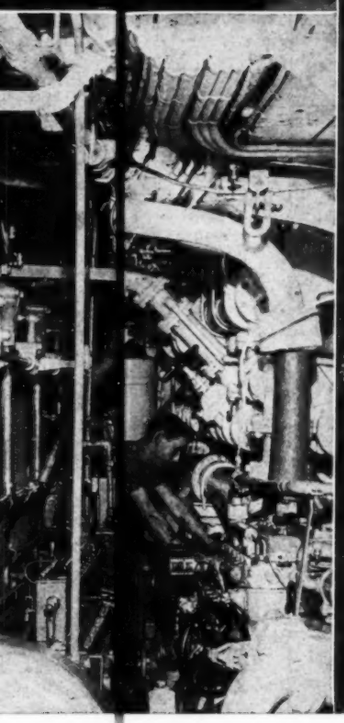
Ocean Tow has eight deep-water, off-shore tugs in service. They are twin-screw vessels, 126 feet long, have a molded beam of 27 feet, and a 13-foot draft. Five of them are powered with twin Fairbanks-Morse 690 horsepower Diesel engines and three have twin 600 horsepower Fairbanks-Morse plants. The ships were designed by L. H. Coolidge, Seattle naval architect, and are known as the Miki-Miki type of ocean-going tug, taking their name from the initial vessel which Coolidge designed for Young Bros., Ltd., Honolulu, several years ago. Used by the army during the war, they proved their stamina in trans-ocean hauls

The tugs were built in 1943 and 1944, three by Barbee Shipyards, Seattle; three by Grays Harbor Shipbuilding Co., Grays Harbor, Wash.; one by Sagstad Shipyards, Seattle, and one by Hodgson Green, Long Beach, Calif

The new Alaska Freight Express operates direct service from Tacoma and Seattle to Seward with four steel barges leased, along with the tugs, from Ocean Tow. The barges, ex-navy, are 260 feet long, 48 feet in beam and are 15 feet deep. They are covered barges, built of molded steel, and have double hulls. They can load 4,000 measurement tons, which gives them the carrying capacity of ocean freighters. Converting them to peace-time maritime usage involved an expenditure of $100,000 on the four of them. These modifications, which included installation of eight huge hatches, were planned by Carl Nordstrom, Seattle naval architect, and carried out by the Lake Union Dry Dock Company for Ocean Tow.

The barges have no motive power, and thus the husky Diesel tugs are depended upon entirely in the new freight service to Alaska. Typical of the five tugs powered with twin 690 horsepower, six cylinder, direct reversible Model 37-E-14 Fairbanks-Morse engines is the Maclofay. These marine Diesels are of the vertical two-cycle, mechanical-injection type. They are pressure lubricated and have oil-cooled pistons. Excess air for scavenging and charging the cylinders is furnished by built-in scavenging pumps. The brake horsepower of 690 is rated at 300 rpm. The bore is 14 inches and the stroke 17 inches. The piston speed is 850 feet per minute.

All the tugs have a fuel capacity of 28,000 gallons. Consumption by the two engines in the Maclofay is about 60 gallons per hour. The engines utilize Fairbanks-Morse fresh water pumps, driven by 15-horsepower electric motors, with a third one on standby duty. The salt water circulator pumps to cool the fresh water and lubricating oil are Dayton-Dowds, driven by 5-horsepower motors, with a third held for a spare and a fourth on fire service. Fairbanks-Morse unit pumps supply fresh water for ship's use and salt water for the sanitary system. Oil purifiers are by Honan-Crane. When the tug's engines are idle, the electric power supply is derived from two 25-kilowatt generators driven by six cylinder 33-1/3 horsepower Hercules Diesel engines. The engine room switchboard, fully automatic, is a Westinghouse Electric Company product. All in all the engine room equipment for these vessels is more than adequate.



The pilot houses of all the tugs are equipped with the most modern of navigational aids and equipment. All have General Electric radar, ranged at two miles, six, and 30 miles. The 65-watt ship-to-shore radiophones are Intervox or Radio Laboratories products, depending upon the tug, while direction finders are by Bludworth. Bendix engine room telegraphs. Weston Electrical Instrument Company tachometers, Modern Engineering Company electrical steering gear and de Giers Liquidometer rudder position indicators all contribute toward making the pilot houses of these tugs as modern as an ocean liner's bridge.

Although engine room equipment varies somewhat with the builder, the tug Osage may be taken as cycle, mechanical-injection type Fairbanks-Morse Model 37-F-12 six cylinder, 600 horsepower, two cycle, mechanical-injection type Fairbanks-Morse Diesels. The fuel consumption of this power plant is approximately 25 gallons per hour. The horsepower rating is at 400 rpm. The bore and stroke is 12 inches and 15 inches. Piston speed is 1,000 feet per minute.

One of the auxiliary 25-watt electric power generators is driven by a six cylinder, 65 horsepower Buda Diesel and the other by a six cylinder, 65 horsepower Hercules. The engines utilize Moran fresh water pumps, while Dayton salt water circulator pumps are used for cooling. Fairbanks-Morse unit pumps are employed in the ship's fresh water and sanitary systems. Switchboard equipment is Square D, General Electric, or Westinghouse, depending upon the tug's builder.

Whether a tug with a total of 1,380 or 1,200 horsepower is used to tow the steel cargo barges, the trip to Seward from Seattle or Tacoma is made in approximately eight days. Although initial service is to that Alaskan city alone, plans call for extending it to southeastern ports in the Territory in an effort to improve freight service to the coastal cities. Head offices of Alaska Freight Service are at Anchorage, with branches in Seattle and Tacoma. L. B. DeLong is president of the company and T. A. Thronson is traffic manager.

And the tugs of Ocean Tow are distinguishing themselves in another field in addition to the Alaskan run, performing a chore that calls for the ultimate in engine power. This project is the towing of gigantic log rafts from British Columbia waters to Anacortes, Wash. The logs are from the world's largest logging project in the Skagit River Basin which extends from northern Washington into Canada. The hauling of these logs from woods to the Fraser River in British Columbia demanded the superlative in Diesel trucks (DIESEL PROGRESS, October) and once at the booming grounds it becomes the chore of Diesel-powered tugs to haul them to mills on Puget Sound, thus making the whole operation of transportation one of Diesel from start to finish.

Between April 15 and October 20, 16 tows of approximately 2,200,000 board feet each were made by Ocean Tow tugs from the north arm of the Fraser River to Anacortes. Seventy sections, or rafts of logs make up each tow, and the lumber represented by one tow is enough to build a board walk three feet wide and approximately 140 miles long. Obviously enough, engines with a good deal of hanging-on power are required to haul such tows against the tides and currents of salt water. Once the rafts are nudged into line by small tugs at the booming ground, a single vessel, either a 1200 horsepower or a 1380 horsepower tug, takes the spectacular tow to the United States.

Ocean Tow, owned by Morrison-Knudsen Co., Inc., and DeLong Engineering & Construction Co., is headed by C. R. Shinn. Martin E. Guchee is port captain.

EUROPEAN PILE DRIVER UTILIZES DIESEL CYCLE

By KALMAN J. DE JUHASZ*

AN interesting and unusual war time European development is the pile driver based on the compression ignition principle; manufactured by the Manfred Weiss Steel and Metal Works Company, Budapest, Hungary. This machine is intended for driving piles for foundations of bridges, dams, buildings and other structures, and it is claimed to possess the advantages of easy portability and erection, simple serviceability; reliability and low fuel consumption. Its high impact force renders it suitable for hard soil conditions.

The complete installation is shown in Fig. 1; it comprises a low carriage moveable on wheels, an I-cross section mast fastened to the carriage and supported on it by a tripod framework, the pile driver machine proper slidably mounted on the mast in a vertical position, and a hand operated winch with cable, pulley and a latch gear for raising and lowering the pile driver as a whole, for starting the machine, and for assembling and disassembling it.

The pile driver machine itself is shown in Fig. 2 in side elevation and longitudinal section. In effect it is a two-cycle, compression ignition, slow speed, air cooled, simple cylinder engine. In this application a straight line oscillatory motion is required, therefore no crank mechanism and no flywheel is needed, whereby the construction is greatly simplified compared with the usual internal combustion engines. The machine is set up with its axis vertical, and can operate only in this position, as the force of gravity is required.

The main parts of the machine are: the cylinder assembly comprising the work cylinder (1) guide cylinder (2) and retaining ring (3); the piston (4) and the ram head (5), both movably arranged in the cylinder assembly; the fuel injection pump (6) with the filter (7) and fuel tank (8); furthermore a necessary accessory is the latch gear (Fig. 4).

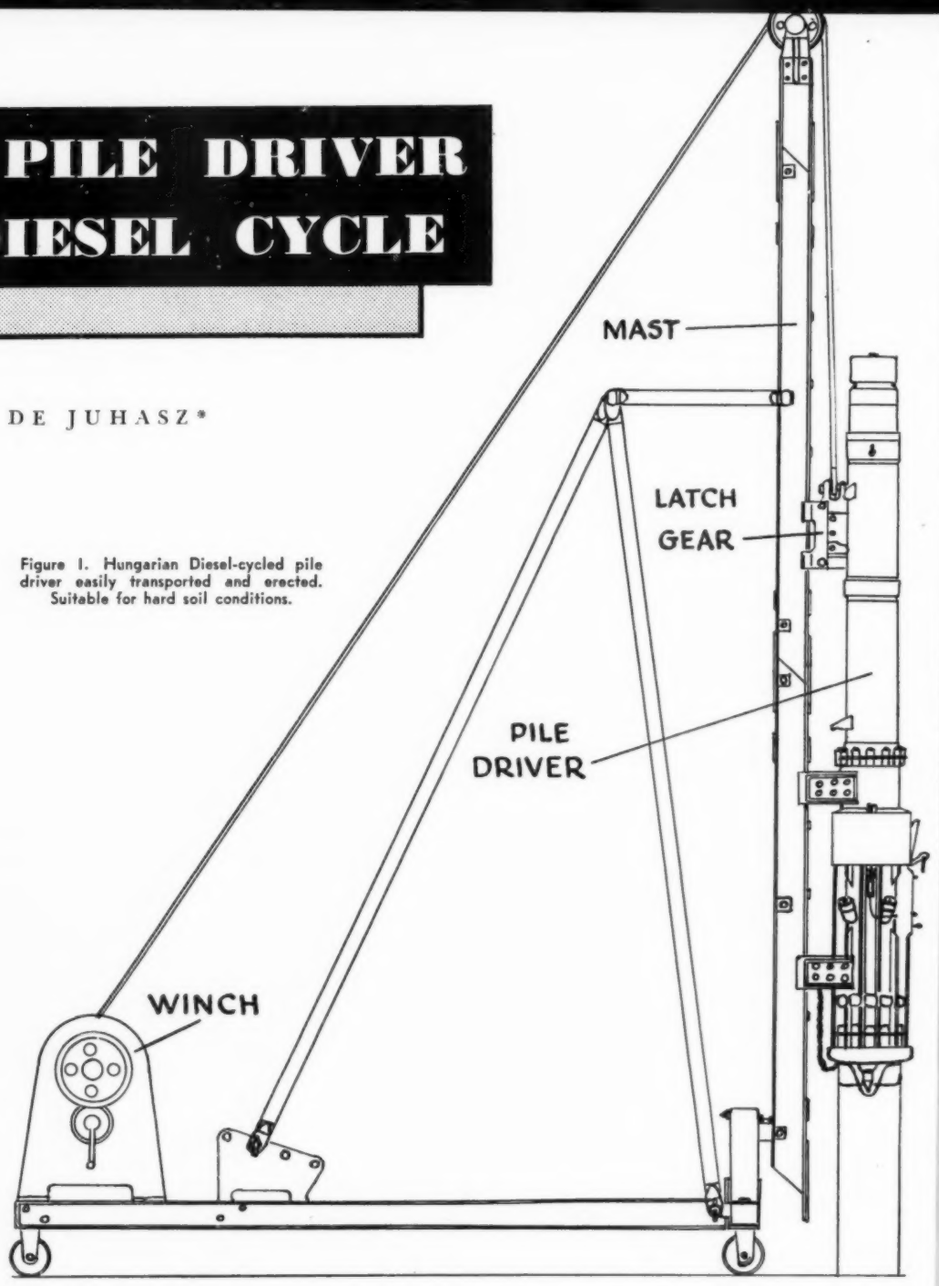


Figure 1. Hungarian Diesel-cycled pile driver easily transported and erected. Suitable for hard soil conditions.

The principal data of the machine are the following:

Piston diameter	=	8.27 in.
Piston stroke (average)	=	59 in.
Height of machine	=	118 in.
Largest diameter	=	14 in.
Piston weight	=	1200 lb.
Total weight	=	2300 lb.
Impact force, max.	=	6600 lb.
Rate of blows, approx.	=	50 per minute
Fuel consumption (approx.)	=	0.025 gal./min.

The three main elements of the cylinder assembly, work cylinder (1) guide cylinder (2) and retaining ring (3) are machined out of mild steel tubing, centered to each other by spigot and recess, and fastened together by cap screws passing through lugs welded to the joining ends of these elements; thus the three elements form in effect a long tube open at both ends. To the working cylinder are welded twelve cooling fins (10) of sheet steel, four lugs (11) for the exhaust and intake openings (all four openings serve for both exhaust and intake), the annular fuel tank (8), the warming-up trough (12), and four brackets (13) to which the sliding paws are fastened with screws. The injection equipment (6) is fastened to the work cylinder with studs and nuts; at the height of the fuel tank a slot is machined in the wall of the work cylinder to allow the lever (14) of the injection pump to protrude into the cylinder, and be actuated by the moving piston. To the guide cylinder are welded: eyelets (15) for lifting the unit and prongs (16) for actuating the latch gear for the release of the piston; a longitudinal slot machined into the wall of the guide cylinder serves to accommodate the lifting finger (30) of the latch gear for engagement with the piston. An arresting pin (2 a) can be made to engage with the groove (4 a)

* *Professor of Engineering Research, The Pennsylvania State College. (Scientific Consultant, Technical Industrial Intelligence Division, Department of Commerce)*

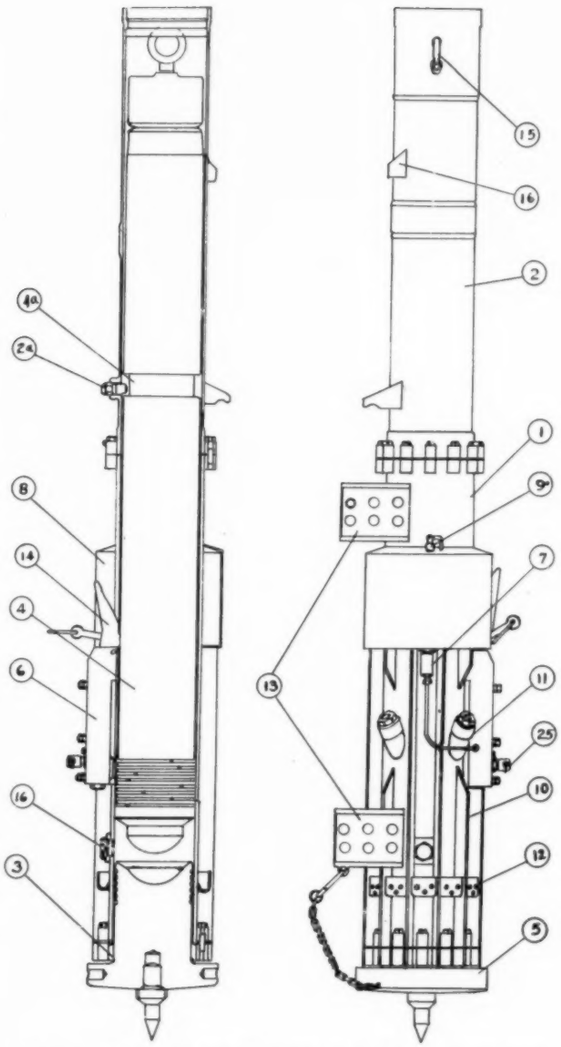
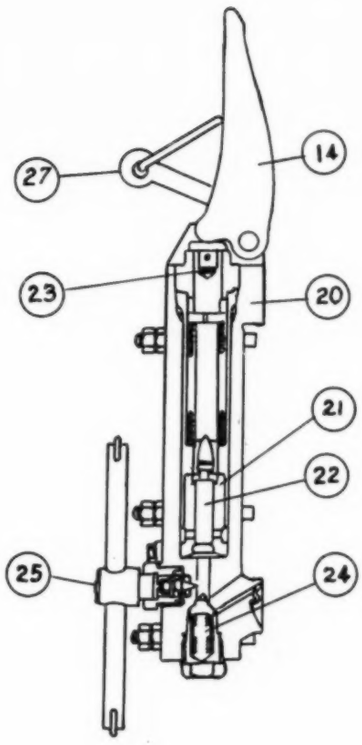


Figure 2. Pile driving mechanism seen in side elevation and longitudinal secton.



Fgure 3. (left) Fuel injection pump is actuated by piston on its downstroke by means of cam lever.

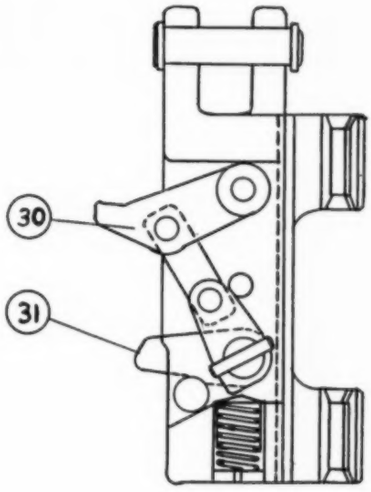


Figure 4. Latch gear mounted on mast holds piston in starting position.

and thereby keep the piston in a stationary position when the machine is at rest.

The piston (4) and ram head (5) are of forged steel and are fitted with cast iron piston rings. A center pin in the bottom of the ram head is driven into the center of the top of the pile to connect the machine securely with the pile. In the top of the piston an eyelet can be screwed for lifting or removing the piston. In the middle of the piston a groove (4 a) of reduced diameter is machined for engagement with the lifting finger (30) of the latch gear (Fig. 4). The space between the bottom of the piston and the top of the ram head forms the combustion chamber; it is accessible for cleaning through a large hole which can be closed with the tight fitting screw cap (16).

The fuel injection pump, Fig. 3, comprises a forged body (20), barrel (21), plunger (22), tappet (23), delivery valve (24), by pass valve (25), and cam lever (14). The cam lever protrudes, through a slot machined in the cylinder wall, into the cylinder and engages with the piston; in operation the piston, on its downstroke, actuates cam lever, thereby injecting fuel into the cylinder. The cam lever can be moved out of engagement with the piston by means of pulling a rope attached to the link (27) forming part of this lever, and thereby the pump rendered inoperative. The fuel tank (8) is an annular shaped chamber, made of sheet steel, of about 1.2 gallon capacity, surrounding the work cylinder. The fuel can be admitted to or shut off from the fuel pump by means of the shut off valve (9) mounted on the top of the tank. At the outflow end, at the bottom of the fuel tank a filter (7) is provided. For fuel the makers recommend a mixture of 85 per cent Diesel fuel and 15 per cent kerosene.

An essential accessory for starting the machine is the latch gear, shown in detail in Fig. 4. Essentially it is a collapsible knuckle joint, slidably fitted to the mast. Through a slot provided in the wall of the guide cylinder the finger (30) protrudes into the cylinder and engages with the circular groove (4 a) of the piston which latter then can be raised by means of the hand operated winch.

At a certain height the air passages (11) are uncovered by the piston and the cylinder space is filled with air. On further lifting the release lever (31) comes into engagement with the lug (16) provided on the guide cylinder, whereupon the latch collapses and releases the piston. On its downward fall at a predetermined height the piston actuates the cam lever (14) of the fuel pump whereby fuel is injected into the cylinder air. On its further travel the piston closes the air ports, and compresses the air-fuel mixture whereby it ignites and burns. It is to be noted that the fuel is injected at the middle of the cylinder and not at the bottom; hence not pure air is compressed but a combustible mixture; this should result in a sudden explosion and not gradual burning, but for the purpose of this machine a sudden explosion is desirable. The combustion pressure acts on the ram head which transmits the force to the pile; the combustion pressure acts also on the piston and accelerates it upwards. On its upward travel the piston uncovers the ports (11) through which the combustion gases leave the chamber and fresh air enters, just like in a two cycle engine; thus the process continues automatically until stopped by the operator.

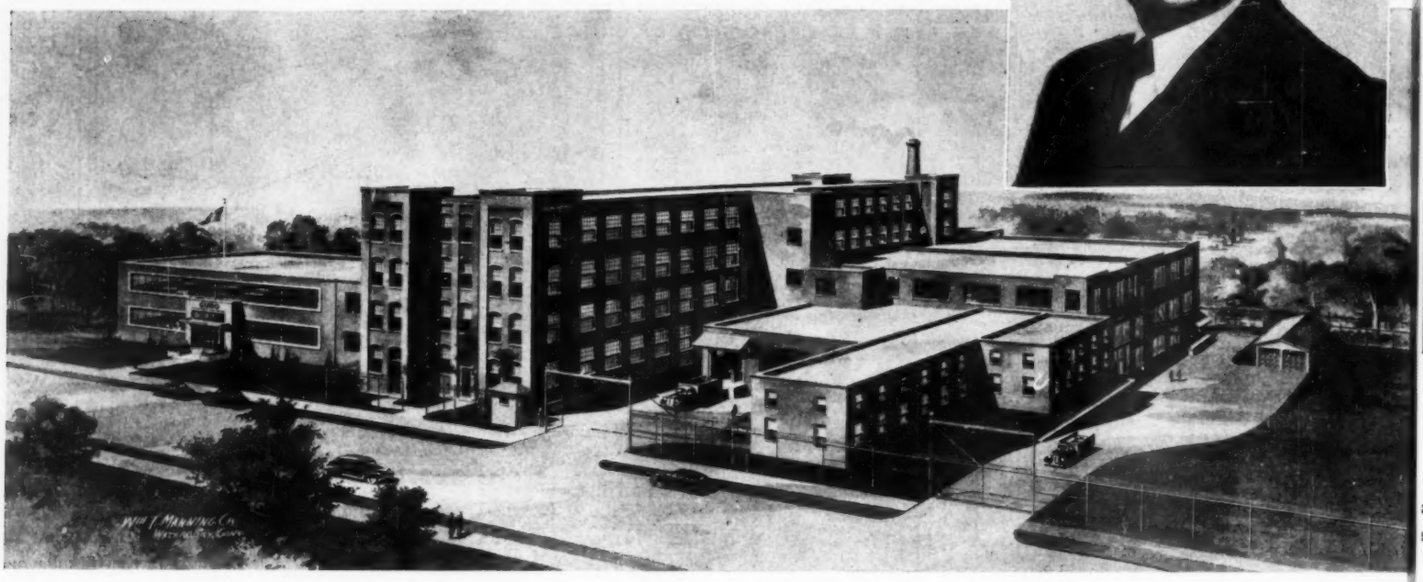
For stopping the injection pump is rendered inoperative either by screwing out the fuel by pass valve (25), or by pulling the cam lever (14) out of engagement with the piston. A graduation of the blow force can be attained by regulating the fuel by pass valve, and thus the amount of fuel injected. In cold weather it is necessary to warm up the machine; for this purpose an annular trough (12) is provided into which kerosene or other readily combustible fuel is placed for burning to warm up the chamber.

The possibilities of a pile driving machine of this type are many. Its 6600 lb. impact force makes it particularly adaptable in driving piles in hard subsurface terrain. Its light weight, 2300 lbs., combined with its ease of transport takes it out of the "heavy equipment" class for all practical purposes. Its fuel consumption of .025 gallons per minute is so low that for ordinary pile driver usage it could be almost ignored.

DIESEL OIL FILTRATION

22-Year Research and Development Program by Filter Manufacturer Discussed.

C. H. Cuno, Chairman of Board, founder of Cuno Engineering Corporation.



Cuno plant as it appears today. Original building occupied since 1912 at center with new administration building left and additional manufacturing space in buildings at right.

By BRUCE C. SISSON

THIS is a story of Connecticut and Yankee ingenuity. Few people realize the wealth that has sprung from the Connecticut river valley and from the thousands of diversified industries which make up that region. "Production," the word so stressed today has been a byword in Connecticut since the days when Eli Whitney built his first cotton gin and when Hiram Maxim and Colt saved the Union with the mass production of breech-loading rifles.

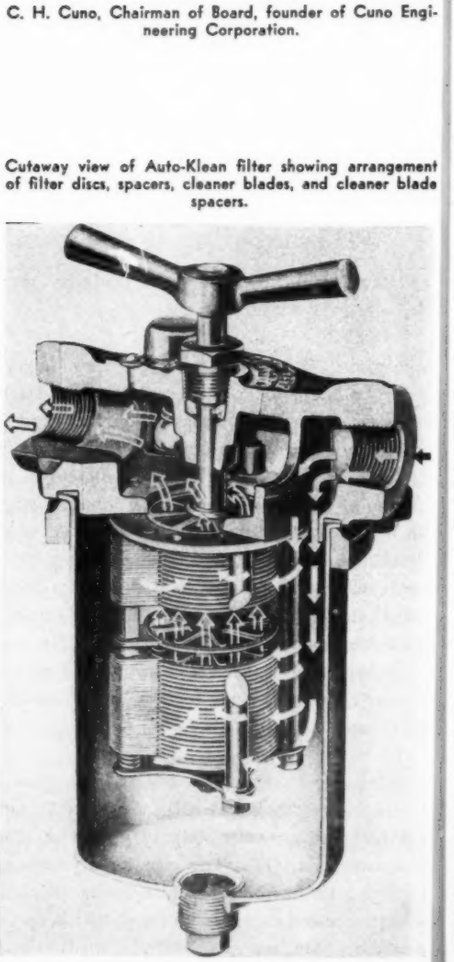
It was the development of the internal combustion engine that led the Cuno's, father and son, into Connecticut industry and resulted in the present outstanding position the Cuno Engineering Corporation holds today. It was in 1912 that Charles H. Cuno and his father, Charles F. Cuno set up the business, consisting of one room and plenty of ingenious ideas. Their first development was an acetylene gas automotive self-starter. This venture showed great promise but the invention of the electric starter with its even greater possibilities caused the Cuno's to withdraw and seek greener fields. This they did in short order, rapidly developing a series of automotive and marine accessories which established their name in industry. These included a marine timer, automotive dash lights, and cigarette lighters. This latter product was the first successful automotive cigarette lighter and was first produced in 1917. Today Cuno produces lighters for many of the leading automobile manufacturers.

In 1926 came the product which has made Cuno world-famous, the metal edge-type filter. The importance of this Auto-Klean filter, as it is called today, is that it could filter out foreign particles from a fluid as small as .0035 in. in size and at the same time could be cleaned without interrupting the flow of liquid through the filter itself. Designed for automotive use the filter soon came to the attention of other machinery users and builders with the result that soon it was accepted by many industries, Diesel among them.

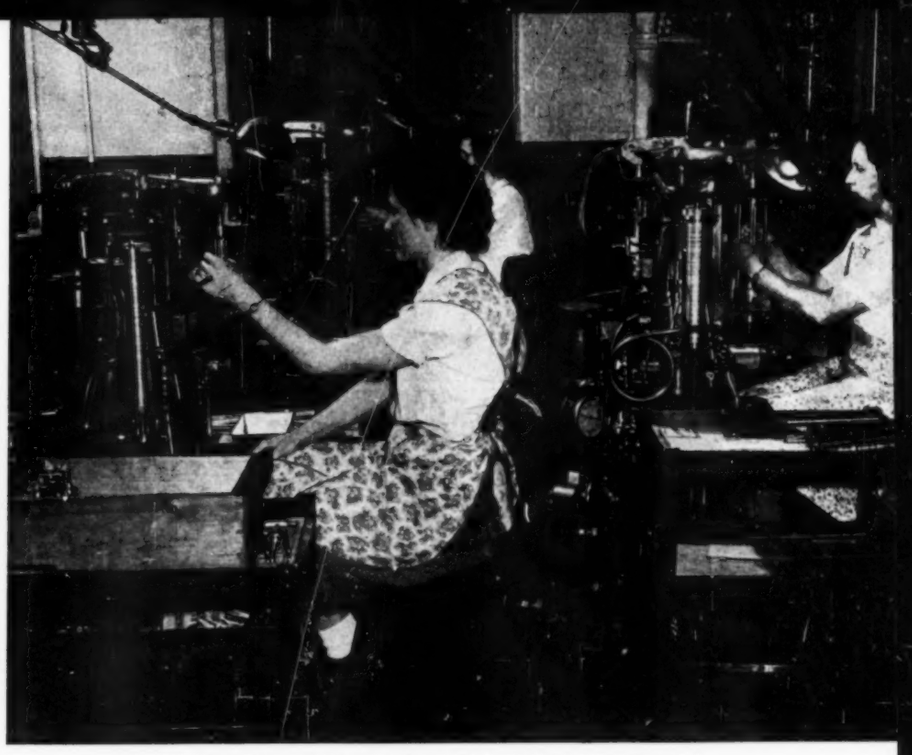
The Auto-Klean filter is essentially a stack of thin wheel-shaped discs separated, each from the other by a metal spacer. It is the thickness of the spacer which determines the degree of filtration. The discs are mounted on a rotable shaft and set in a filter case. Cleaning of the filter is accomplished by turning the stack of discs and spacers past a series of knife-like stationary blades which comb out solids deposited and drop them to the bottom of the case where they are easily removed.

The manufacture of this edge-type filter involves

Cutaway view of Auto-Klean filter showing arrangement of filter discs, spacers, cleaner blades, and cleaner blade spacers.



Cuno Micro-Klean filter dismantled showing filter case, cartridges, and other component parts. This filter will handle 25 gallons of 150 ssu oil per min.



Cuno-developed filter stacking machine which automatically stacks filter parts in proper order. Warning signals notify operator if sequence is disturbed. It is called "Dancing Lady" by employees.

an unusual stamping problem inasmuch as each stamping of disc or spacer must be free of burrs.

Usually sub press equipment would be required but Cuno has developed methods whereby high speed press equipment can turn out perfect stampings. Another factor which is important in the manufacture of these filters is the necessity for metal of the proper thickness. Without metal of absolute dimensions serious assembly problems would result.

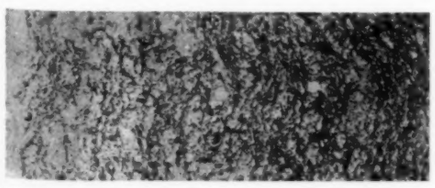
Cuno's greatest expansion occurred during the recent war with the demand for filters by the Armed Forces. New manufacturing space was required and resulted in the building of a new two-story building for administrative personnel, leaving more space in the original plant. But this move did not solve the problem and two sub-plants were set up in Meriden to handle assembly and storage. In addition to this the company had 26 sub-contractors located throughout the east and midwest helping supply vital parts. As a result of this effort tens of thousands of Cuno products found their way to all parts of the world.

During the war period however Cuno engineers were not resting on their laurels. As a matter of fact, work had already begun on an entirely new method of filtration. Realizing the need for very fine filtration especially in Diesel applications Cuno engineers using the resources of the Armour Research Foundation in Chicago in the summer of 1942 began their search for a filtering media which would remove a great proportion of harmful solids from lubricating oil and yet be porous enough to permit satisfactory flow characteristics with low pressure drop. Exhaustive studies of all phases of industrial filtration were made. Animal, vegetable and synthetic fibres were tested. Experiments were made with new types of bonding materials. Various methods of controlled felting were investigated. Thousands of tests were run both in the field and in the laboratory. In January 1946 final developments were made on the new filter, preparatory to putting it on the market.

During that same period a series of tests were made in Chicago at the Armour Research Foundation, sponsored by Cuno, which proved beyond any doubt that lubricating oil filtration cut engine wear considerably.

This new filter incorporates the principle of depth filtration. This is accomplished by a special process of controlled felting which permits the control of the density of the felted fibres which make up the cartridge. After felting, the cartridge is specially impregnated with resin to bond the fibres in position and provide structural strength. The felting is so controlled that the outer surface of the cartridge stops only the larger particles while the smaller micronic particles are trapped in depth according to their respective sizes. It is claimed that the cartridge will remove all particles larger than 25 microns (.001 in.) and the greatest proportion of particles down to one micron. Other cartridges, offering filtration to other micron sizes are also being prepared.

(Below) Microphotograph of Micro-Klean filter element show progressively greater fibre density from left to right. This resin impregnated fibre media is result of long research and testing.



The Micro-Klean cartridge as this cartridge is called has proved itself to have long service life. On a series of recent tests these cartridges ran up a total of 437 hours on a Diesel engine test stand whereas previously no filter had approached this standard of efficiency. The chart below illustrates the performance of the Cuno filters.

Test Results

Application: Test Stand Lube Oil—800 H.P. Diesel Engine. Oil: SAE 40, Flow Rate: 75 GPM
Operating Temperature: 160—180° F
Cartridges Used: Micro-Klean #2278F1—32 cartridges in competitive housing
After 174 hours operation
Inlet Pressure: 15 PSI at filter
Outlet Pressure: 13 PSI at filter
After 437 hours operation
Inlet Pressure: 18 PSI at filter
Outlet Pressure: 14 PSI at filter
Total Volume of oil handled: 1,966,500 gallons
Gallons handled per cartridge: 61,450 gallons
Flow rate per cartridge: 2⅓ GPM

The above tests were made by the engine builder and show the effectiveness of the Cuno product. Cuno has continually stressed the advantages of full flow filtration over any partial filtration system. Their position on this point was proven by the test results supplied by the Armour foundation which showed that engine wear rates were considerably lower when full filtration was used in preference to partial filtration. Now, with the Micro-Klean filter available to supplement Cuno's edge type filter, the Diesel engineer is given additional tools to further the development of full flow filtration of lubricating oils.

D. E. M. A. ELECTS GORDON LEFEBVRE PRESIDENT

View of speakers' table at luncheon during Annual Meeting of Diesel Engine Manufacturers Association.

GORDON LEFEBVRE, President of the Cooper-Bessemer Corporation, was elected the new President of Diesel Engine Manufacturers Association, at the Association's Annual Meeting, held Dec. 10, in Chicago.

Otto H. Fischer, President of The Union Diesel Engine Co., and L. W. Metzger, Vice President of The Baldwin Locomotive Works, were elected new Vice Presidents of DEMA.

Robert H. Morse, Jr., Vice President and General Sales Manager of Fairbanks, Morse & Co., was re-elected Treasurer of the Association and Harvey T. Hill was reappointed Executive Director.

Elected to serve two years on the Board of Directors were George W. Codrington, Vice President of General Motors Corporation and General Manager of Cleveland Diesel Engine Division; E. J. Schwanhausser, Vice President of Worthington Pump & Machinery Corp.; A. W. McKinney, Vice President of The National Supply Co.; Mr. Morse, and Mr. Metzger mentioned previously.

The following were elected to serve one year on the Board: C. S. Herbert, Executive Vice President, Enterprise Engine & Foundry Co.; W. E. Corrigan, Vice President, American Locomotive Co.; Robert E. Friend, President of Nordberg Manufacturing Co.; Mr. Lefebvre and Mr. Fisher.

The Annual Meeting, together with the DEMA engineers' session held on Dec. 9 and 10, comprised the most important and the most successful gathering that the Association has ever held. It was important because significant issues were discussed and dealt with; successful because real progress was made in the two days that the engineers and executives talked out their problems.

One of these was the growing seriousness of the situation with respect to supply and demand of Diesel fuel oil. To get an authoritative, first-hand picture of the situation, the DEMA personnel had as their luncheon guests some of the top men in the oil industry, who represented the marketing division of the American Petroleum Institute. They included A. W. Peake, President of Standard Oil Co. (Indiana); L. S. Wescoat, President of Pure Oil Company; P. E. Lakin, Vice President of Shell Oil Co., Inc.; B. L. Majewski, Vice President of Deep Rock Oil Corp.; and John Day, Executive Secretary of Western Petroleum Refiners Association.

Mr. Schwanhausser summarized briefly the mounting demands of Diesel installations for fuel and lubricating oils. Mr. Majewski acknowledged that "you Diesel people have really thrown a load on us." This was amplified by Mr. Peake who said "the demand for all petroleum products—for Diesel engine fuel and lubricating oils in busses, trucks, tractors . . . has increased to a staggering extent since the war. We will not be able to meet all the requirements alone, but will have to bring in foreign production. That will take several years."

Mr. Wescoat explained that a shortage since the war of materials, manpower and transportation had hampered oil production, but said that the industry "was doing everything it could to cope with a problem which developed out of a clear sky, and which was never anticipated."

Mr. Lakin said that any study of Diesel oil specifications on the part of the Diesel industry, "that leads to simplicity and uniformity will enable the oil companies to do a better job." Mr. Majewski put the case more tersely: "If you are not too tough in this matter of specifications, you'll get more Diesel fuel."

Upshot of the discussion was that Diesel Engine Manufacturers Association agreed to make a survey of how much Diesel engine horsepower is now located in each state of the union, together with an estimate of how much this amount of horsepower would increase over the next five years.

* * * *

The Annual Meeting began with an account of DEMA's 1947 activities, together with its plans for 1948 and succeeding years. Mr. Schwanhausser, retiring President, reviewed the Association's legislative activities, educational program and furthering of public relations. During 1948, he said, DEMA will publish two books: "Marine Diesel Standard Practices" and a Spanish edition of "Standard Practices for Stationary Diesel Engines."

Commenting on the educational program, which is being undertaken with the cooperation of parts, accessory and oil companies, Mr. Schwanhausser said: "It is the finest job being done by any organized group of business men, in working to improve the quality of students being graduated to go to work in their companies."

* * * *

The engineers who had been delegated by their companies to represent them, met with Ralph

Boyer, Vice President and Chief Engineer of Cooper-Bessemer Corporation, as their chairman. A discussion of bearings, led by George Steven, Executive Engineer for Worthington Pump & Machinery Corp., was the first event of the program. Next came the formulation of recommendations for preventing crankcase explosions—this at the request of Arthur R. Gatewood, Chief Engineering Surveyor of the American Bureau of Shipping, who was present. Gordon R. Anderson, Director of Engineering for Fairbanks, Morse & Co., discussed dual fuel engines.

T. M. Robie, Manager of Fairbanks, Morse's Diesel sales division, opened the second and concluding day of the engineers' session by reporting the progress made in setting up the meeting, next May, of the Oil & Gas Power Division of the American Society of Mechanical Engineers. The meeting will take place in St. Louis May 19 to 21. A session of DEMA's engineers will be held on the day previous.

In revising "Standard Practices for Stationary Diesel Engines" for its Spanish edition, it might be well to provide a supplement, in the form of a pamphlet, to take care of dual fuel engines, the engineers decided. They also concluded that a separate derating chart for turbo-charged engines would be necessary.

George H. Amberg, of DEMA's staff, gave a report on the Association's educational program. Consensus of the engineers was that most college graduates were interested more in sales work than in design. All the engineers present felt that the students should be given more college instruction in design work.

At DEMA Engineers Meeting: Top panel view, Left to right—Hans L. Wittek, Director of Research, Hallett Mfg. Co.; G. F. Noltein, Chief Engineer, The National Supply Co.; Carl A. Jacobson, Consulting Engineer, The Baldwin Locomotive Works, shaking hands with George J. Rathbun, President, The Rathbun-Jones Engineering Company.

Second panel view: Left to Right—Leslie D. Calhoun, Chief Engineer, Fulton Iron Works Co.; B. G. Valentine, Chief Engineer, Sterling Engine Company; T. H. Murphy, Diesel Engineering Dept. (Schenectady), American Locomotive Company, and Austin Sherman, Vice President, Hallett Mfg. Co.

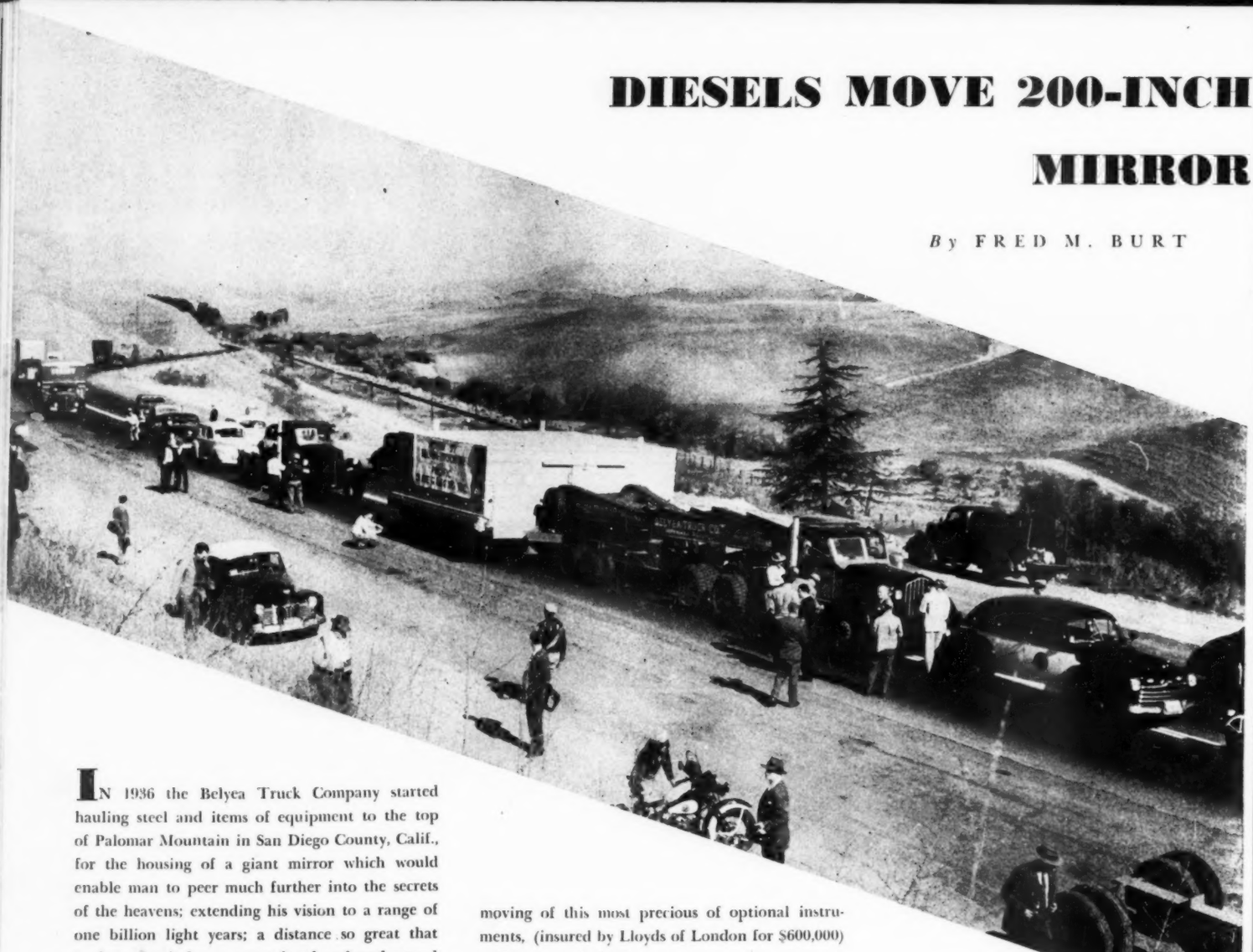
Third panel view: Left to Right—Roy A. Hundley, Chief Engineer, Enterprise Engine and Foundry Co.; Charles E. Fike, Chief Electrical Engineer, and Knute O. Keel, Chief Engineer, Cleveland Diesel Engine Division, General Motors Corp., and Otto H. Fischer, President of the Union Diesel Engine Co.

Fourth panel view: Left to right—Gordon R. Anderson, Director of Engineering, Fairbanks, Morse and Co.; Emil Grieshaber, Chief Engineer, Nordberg Mfg. Co.; E. J. Schwanhausser, Vice President, Worthington Pump & Machinery Corp., and Ralph Boyer, Vice President and Chief Engineer, The Cooper-Bessemer Corp.

Fifth panel view: Left to Right—Robrt S. Ogg, Engineer in charge of Patents, Lima-Hamilton Corp.; J. P. Hyde, Chief Engineer (Philipsburg) Ingersoll-Rand Co., and George Steven, Executive Engineer, Worthington Pump & Machinery Corp.

DIESELS MOVE 200-INCH MIRROR

By FRED M. BURT



IN 1936 the Belyea Truck Company started hauling steel and items of equipment to the top of Palomar Mountain in San Diego County, Calif., for the housing of a giant mirror which would enable man to peer much further into the secrets of the heavens; extending his vision to a range of one billion light years; a distance so great that no human mind can comprehend and understand it. (If all of the Diesel trucks in the world were to travel 1,000 mph. for 1,000 years, the combined mileages would hardly be a perceptible start on such a huge distance.)

Those were the days when the road up Palomar Mountain was just an improved trail. Loads were delivered to the foot of the mountain and then transferred to single Diesel units in order to negotiate the trail.

Also in 1936, the 200 inch diameter, 24 inch thick, 15 ton glass casting arrived in Pasadena, from Corning (N. Y.) Glass Company. Belyea Truck Company, along with its subsidiary Pacific Crane & Rigging Company, unloaded this valuable cargo from the railroad car to heavy duty trailer, Diesel tractor equipment, and transported it safely to the shops of Pasadena's California Institute of Technology for polishing.

During the next eleven years, work progressed until finally in October 1947, the final polishing was completed, with a surface finished to within two millionths of an inch of absolute accuracy. As a climax of years of fine service to Cal Tech, the Belyea companies were entrusted with the moving of this most precious of optional instruments, (insured by Lloyds of London for $600,000) to its mountain home.

Engineers of Cal Tech, together with Belyea key personnel, worked out details of the long trip. Particular attention was paid to the selection of equipment with emphasis being placed on even weight distribution and shock absorption.

The equipment used consisted of one Fruehauf, double goose-neck lowbed trailer pulled by one Diesel tractor. There were 42 Budd wheels and 42 Westinghouse air brakes on this unit. On the last 12 miles, up the mountain, in addition to the tractor in front, a similar Diesel tractor and a Diesel truck were used as pushers. This added up to 62 Budd wheels and 62 Westinghouse air brakes. The power units were Sterlings, F-C-S, with 150 hp. Cummins HB Diesel engines, 7851 Brown Lipe transmissions, 703 Auxiliary transmissions, splicer clutches, drive lines and universal joints. Gear ratio 8¼ to 1, with 15 speeds forward and 3 reverse for a total of 18.

Due to the location of the 120 ft. x 120 ft., air-conditioned, optical shop, it was necessary to disconnect the lowbed trailer and move it about 100 ft. on 4 in. orange-wood rollers to a point under the craneway. The only alterations on the trailer was the welding of I-beams to the bed to further equalize the stress and strains.

Thin aluminum plywood foil, and brown paper protected the "eye's" surface; the mammoth "cell" with which it will be mounted in the yoke-and-horseshoe telescope fittings, already had been bolted to the waffled underside. Five red-painted I-beams were fastened to this cell. The 50-ton crane picked up this 35-ton package and lowered it onto the trailer bed, fitting it to a sponge rubber base and permanent steel anchors, then bolting it fast. After this 45-minute job, another hour was taken in lowering and fixing the five-ton 20 ft. square, 8 ft. high, packing-box cover over the mirror for protection.

Installed inside the box on top of the mirror, were delicate, vibration-measuring instruments registering on a machine outside the building, to show a red light at a movement danger point, with a good safety factor. Project engineer Bruce Rule and Marcus Brown, in charge of the Cal Tech Optical Shop, watched the instrument while this first movement was made, in which the "Eye" had to make

a 90-degree angle turn around a corner with but ¾ inch clearance. Every inch of this movement had been carefully plotted with a liberal use of the slide rule, and blue-printed, comprising, according to Jack Belyea, "the toughest part of the whole job." Then it was a simple matter for Head Driver Lloyd Green to back the Diesel tractor and goose-neck "jeep" under the gooseneck of the lowbed trailer for a smooth connection. Byron Hill, Chief Engineer of the Palomar Observatory and Harvey Sitton, Chief Rigger for Pacific Crane and Rigging, Inc., were also closely concerned in the direction of the operations of preparation and moving.

The mirror delivery was first scheduled for November 12th and 13th, but the forecast indicated bad weather, so it was postponed to the 18th and 19th, when a good forecast was forthcoming. The 127 mile trip to Escondido was scheduled between 3:30 A.M. and 6 P.M. and the trip started right on time. Fifteen California Highway Patrol officers led by Sgt. C. M. Martin paced and trailed the big motorcade. In the cab with Lloyd Green and relief driver Earl Winston, was the instrument that registered the amount of vibration picked up from the gages on the mirror. In passenger cars were Cal Tech engineers. Following were the Diesel tractor and truck that were to be pushers up the mountain. The latter carried Diesel fuel, lubricants, spare tires, water, a lighting plant, welding outfit including flame cutting equipment, fire extinguishers, and other tools and supplies, also a master mechanic.

The first leg of the journey was made without a hitch, arriving in Escondido at 5 P.M. an hour ahead of schedule. The travel speeds varied from ½ to 15 miles per hour, except for a speeding up to about 20 mph. on a smooth stretch, but the red light soon indicated a slow-down. Diesel fuel consumption for the three units was 129 gallons. With a 70 ton weight to be provided for, special preparations had to be made at four bridges. At three smaller ones, 4 in. x 12 in. x 18 ft. decking was laid with shoring beneath.

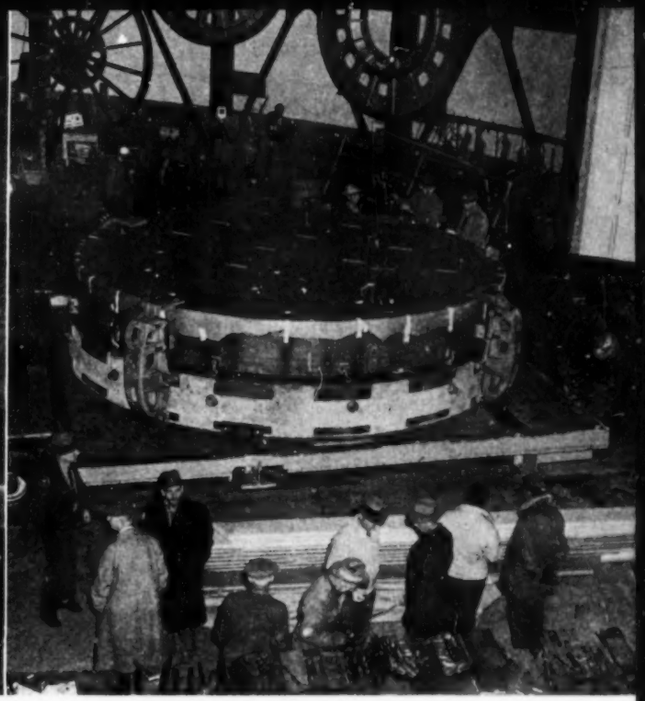
At the Galivan Bridge, to give a wider weight distribution, the trailer was jacked up enough to insert an eight-wheel dolly on each side under the projecting I-beams. After crossing the bridge they were removed.

The second 33 mile leg of the trip was scheduled for between 5:30 A.M. and 3:30 P.M. the next day, with elevations varying from 60 feet to 5500 feet above sea level. A 5 A.M. when the Diesel engines were being warmed up, Byron Hill came down from the observatory to tell of very poor visibility due to an unpredicted flash storm having come up. But this didn't faze Jack Belyea as they had often handled much harder jobs in worse weather, without too much trouble, due to their policy of extraordinary provisions to meet all possible contingencies. He decided to move on to Rincon at the foot of the mountain, 12 miles from the destination. Starting at 5:30, this trip was made ahead of schedule at from 4 to 6 mph., without incident. At Rincon, a ranger coming down the mountain through hail and snow, reported zero visibility, but no indication of a freeze to affect traction. So Jack Belyea again decided that his equipment and crew were fully equal to the occasion. The extra goose-neck "jeep" was removed that curves could be negotiated. The pusher tractor and truck units took their places, to complete the trip at 11 A.M., about four hours ahead of schedule. They had to slow down to a mere crawl when crossing about a dozen cattle guards, whose cross members were spaced 8 in. apart.

It rained at first, and at higher altitudes, there was sleet and then snow. When among trees, men in the rear truck couldn't see the head end. A man stood on the mirror case, all the way up, to assist in signalling, in addition to the code of the blinker lights on the sides and rear of the case, controlled from the lead cab.

All of the careful engineering, the skill of the drivers, and the dependable equipment finally paid off when the long rig, with its precious cargo, finally pulled up to the observatory, backed in and the mirror was taken from its case, with the heavy weight of responsibility lifted from Jack Belyea and his crew. One of the Cal Tech officials was seen to point to the sign "Dependable Delivery" on the side of a Belyea truck, as he shook hands with the driver. According to Robert D. Belyea, it was only through the splendid cooperation of the State of California Highway Department, Los Angeles County Road Department and the San Diego County Road Department, that this job was so expeditiously accomplished with no untoward incident.

Sterling tractor with Cummins Diesel engine begins long haul up Palomar Mountain with precious cargo.



At the observatory after long haul up mountain mirror rest on trailer. Packing box has been removed.

But if you will ask one of the Belyeas (as I did) they will tell you that in-so-far as difficulty and responsibility is concerned, this was just another job, albeit unusually prominent in public consciousness and widespread press consideration. In fact it can truthfully be said that they are engaged in the moving of anything that needs moving, of any size, quantity, shape or material, that falls within the realm of feasibility. The harder and more unusual the job, the greater the likelihood that the Belyea companies will be called upon for service.

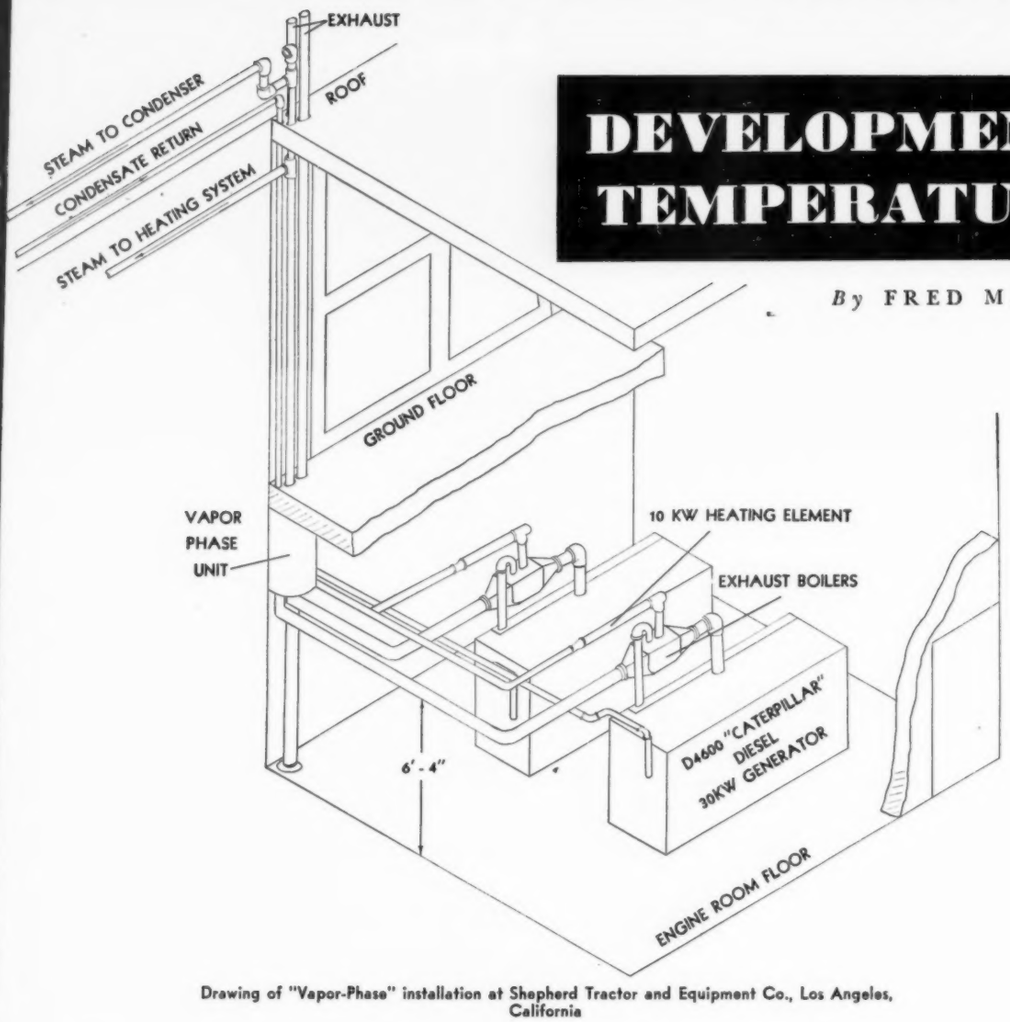
Included in their hundreds of items of diverse equipment, to meet nearly every conceivable need, are lowbed trailers that will move right along with 150 ton loads, pulled by one Diesel tractor. The slogan "Dependable Delivery" is based heavily on the 44 Diesel units, 10 ton and up capacities. The majority have Timken 4-wheel drives, all have three axles. Diesels are used for all of the heavy work. The majority are Sterlings, with some Autocar, Mack, Peterbilt, and White units, all powered with Cummins, 150 hp. Diesel engines, except for three special jobs of 200 hp. 29 are tractors, 15 are trucks.

The three units used on the mirror-moving job, had nothing special about them, just picked out of the big fleet of Diesels kept in top operating condition at all times, under the Belyea standard maintenance and overhaul program. With three extra Cummins Diesel engines on hand, whenever an engine requires an overhaul, it is pulled and a previously overhauled unit takes its place.

Diesel power is also extensively used in the companies' numerous bull-dozers, ditch-diggers, shovels, cats, and various cranes and hoists of up to several hundred tons capacities.

DEVELOPMENTS IN HIGH TEMPERATURE COOLING

By FRED M. BURT *and* BRUCE C. SISSON



Drawing of "Vapor-Phase" installation at Shepherd Tractor and Equipment Co., Los Angeles, California

FIFTEEN years ago anyone who would have stated that Diesel engines could operate most efficiently at cooling water temperatures upwards of 212° F. would have been hooted out of the clan. It was impossible! Cooling water from the engine at 140° F. was a definite risk, let alone 212°. True, many operating engineers had experienced temporary periods, due to cooling system breakdowns, when temperatures reached the boiling point without any apparent damage to the engine, but in such cases engines were shut down and repairs made. In isolated cases, however, it was sometimes necessary to keep the Diesels operating, regardless of cooling system failure. One case in particular is interesting to note. It happened in Virginia at an REA power plant. The supervisor had been called to Washington and had left his young assistant in charge with instructions to keep the plant operating under any conditions.

The day after the supervisor arrived in Washington he received a wire from his assistant to the effect that the cooling tower at the plant was out of commission and that he had better return home pronto. The return trip was the fastest ever made.

As he drove down the mountain pass into the Shenandoah Valley he saw the plant below in the Valley. And, he noted also the bright red of fire engines clustered around it. Fearing an explosion or some other accident he gave the car a little more throttle.

As he drove up to the plant, he noticed no undue commotion, as a matter of fact everything seemed normal except for the presence of the fire trucks and the fact that the Diesels were a little noisier than usual. He found out what had happened very quickly. As he had been telegraphed the cooling tower was out of commission and his assistant had had the foresight to uncover the cooling pipes leading to the tower and requisition the local fire company to spray them with cold water and thus permit the continued operation of the Diesels.

Inside the plant everything was going as smoothly as could be expected. The engines were knocking and steam was escaping from a return valve. That was all that seemed to be happening. He experimented with the injection timing and cut down the fuel supply slightly and found that the engines could develop rated horsepower with less fuel than previously. In so doing the knock was eliminated and the engine seemed to operate more quietly than he had ever known it to.

In the meantime a valve in the return line was cracked slightly to allow the steam to escape more freely and keep the pressure down.

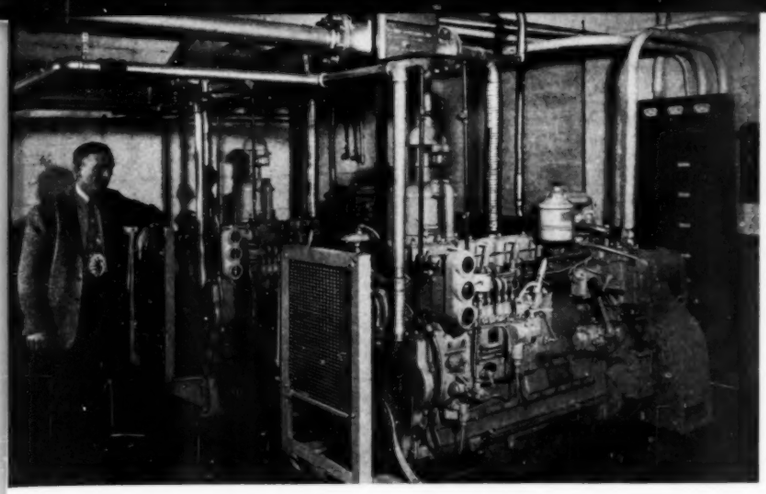
The engine operated for three full days under these conditions while the cooling tower was being repaired. That was how one operator learned that Diesels can operate at the boiling point.

The above described event occurred in 1937, just about the same time that experimentation was begun on high temperature cooling in this country. However previous to this beginning, English engineers were studying the effects of high temperature operation on cylinder liners. The research work carried on by E. G. Williams for the British Institute of Automobile Engineers resulted in some very pertinent conclusions. It was found that rapid wear occurred at cylinder wall temperatures below 194° F., while at temperatures from 194° F. to 536° F. liner wear was practically negligible. In addition it was found that while operating in the higher temperature range none of the corrosive elements of burned fuel could condense and form metal-destroying compounds such as sulphuric, nitric and carbonic acids.

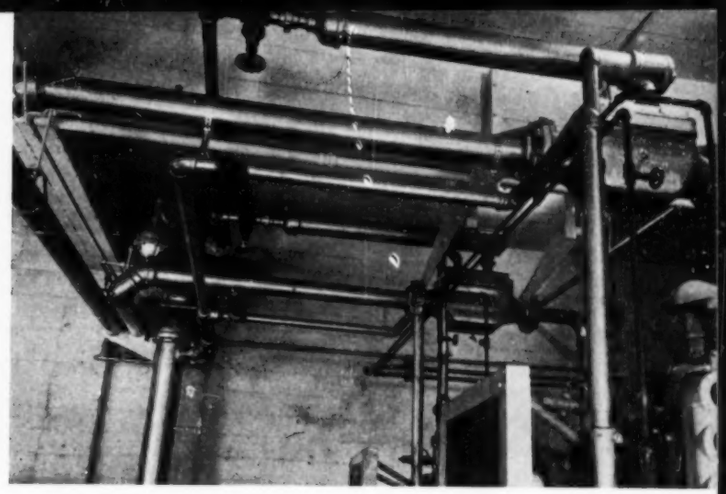
In America, as usual, someone decided to take advantage of these tests and use them in a way which would benefit Diesel users. It had long been known that only 1/3 of the fuel energy going into a Diesel combustion chamber came out as shaft horsepower, the rest went into heating jacket water and oil, stack and radiation losses, and mechanical friction. Why, thought the engineers of Engineering Controls, Inc., can't we raise the efficiency of internal combustion engines by raising operating temperatures to the point where useful heat may be extracted from the cooling water and at the same time increase the life of the engine itself. That step was the beginning of the Vapor-Phase system.

They began by taking a page from the steam engineer's handbook, the fact that at 212° F. water under atmospheric pressure requires 970 Btu's per pound to change it into steam at 212° F. Whereas 1 Btu is sufficient to raise one pound of water 1° F. at lower temperature. The advantage of utilizing this latent heat of vaporization for cooling cylinder is that heat is transferred rapidly and efficiently, much faster than by water below the boiling point.

The operation of a Vapor-Phase unit is simple. It does not begin to operate until the engine comes up to boiling temperature. A thin layer of steam bubbles form around the hottest part of the cylinders, these bubbles detach themselves and pass to the "Vapor Phase" unit above the engine where



Two Caterpillar Diesel-electric sets used to supply heat and power. Plant Engineer G. G. Thomas Sr. at left. Exhaust boilers seen above engines.



"Vapor-Phase" unit shown at top left flashes steam generated by Diesels. Auxiliary electric immersion heaters at top heat water when additional steam is required.

steam is formed at 212° F. This steam is available for heating or processing work. After this it is condensed and the condensate returns to the Vapor-Phase unit where it is heated to 212° F. again. It then passes to the water pump for recirculation through the engine. No steam is formed in the engine to create steam pockets. Most modern engines are designed for a temperature differential of not more than 10° F. which is suitable for Vapor-Phase. Older engines may require some alteration for use with the "Vapor-Phase" system. This may consist in removing baffle plates, etc. Another factor to be considered is the size of the water passages in the cylinder head. These must not be restricted. However most modern engines have sufficient head cooling capacity.

An operating temperature of 212° F. is not the only one possible with Vapor-Phase. Depending on the pressure of the system, temperatures up to 240° F. can be used. The pressures and the resulting temperatures are dependent upon the amount of pressure the water seals will safely stand. Higher temperatures are useful in processing operations where higher steam temperatures are required.

Some of the advantages of this system of cooling include the following: Faster heat transfer from engine cylinders to cooling water, more uniform liner wall temperatures resulting in uniform piston-cylinder clearances during full stroke, better cylinder lubrication, prevention of condensation with in the cylinder, with the result lessening of liner and piston wear.

The operation of the "Vapor Phase" system can best be explained by reference to an actual installation made recently on the West Coast. In the large, new plant of the Shepherd Tractor and Equipment Company in Los Angeles, in addition to the ultra-modern layout and equipment units discussed in the October 1947 issue of DIESEL PROGRESS, a new Diesel plant is now in full and constant operation. Besides producing all the power required for the many shop machines and tools, the air compressor, three 300 ampere arc welders, and various other items of equipment, the engines through use of the "Vapor-Phase" Cooling and waste heat recovery systems, steam heat is supplied to the huge Parts Department and stock room.

Power is supplied by two "Caterpillar" Diesel-electric sets, 110/220 volts, 3-phase, 60-cycle each of 37.5 kva. They are housed in a 20x40 ft. basement room with a high ceiling. Even with the "Vapor-Phase" unit and exhaust heat exchanger in the room the temperatures never become uncomfortably high.

To outline the heat recovery analysis—the average power load is 45 hp. Diesel fuel consumption at .45 lbs. per bhp. hour gives an hourly fuel consumption of 20.1 lbs. At 19,000 Btu's per pound of fuel, this represents an input of 380,000 Btu's for the 45 hp. output. About 31%, or 118,000 Btu's, is used for power, leaving a balance of 262,000 Btu's as an hourly heat loss without the "Vapor-Phase" heat recovery from the water jackets and exhaust manifold, and the heat recovery from the exhaust boilers. At this average rate of power output, about 55% of this wasteheat, or 145,000 Btu's, is recovered by the "Vapor-Phase" and exhaust boiler systems, thus giving the plant an overall thermal efficiency of approximately 70%—quite a bit better than 31%.

Two 10 kw. immersion heating elements, installed in the line between the waste heat boiler and the "Vapor-Phase" unit, utilize electrical power from the generators to supply more heat when it is required. In this manner the power and heating loads may be balanced off. In addition to supplying heat for the building, the power plant itself is kept at a uniform temperature regardless of engine load with resultant better operation.

The "Vapor-Phase" system has been utilized extensively on the West Coast and has been applied to a wide range of engines including automotive and stationary. In one particular instance the system was chosen for its silencing effect on Diesel exhaust. The installation was made on a Navy sound truck which required a sound level of 50 decibels at 10 feet with the International Harvester Diesel operating at full load. Engineering Controls, Inc., was given the job. The engine compartment was specially insulated to reduce mechanical noise. A special air intake silencer was installed on the engine. A "Vapor Phase" unit and a waste heat boiler were installed on the Diesel and a special blower and condensing unit was installed to condense the steam in the system. The result of the installation was the reducing of the exhaust temperatures to under 250° F. and the reduction of noise to the required minimum which the Navy required.

The U. S. Navy has shown an increasing interest in "Vapor-Phase." One Naval installation in particular aboard an auxiliary vessel utilized a single "Vapor-Phase" unit for 4 Diesels including a 350 hp. Atlas propulsion engine and 3 auxiliaries. The system permitted keeping the engines at operating temperature even when they were shut down by operating one auxiliary. Thus the utilization of engine power without the customary warm up periods was possible. In addition to this the engines supplied hot water and heat to the vessel. The addition of small exhaust boilers on the auxiliary Diesels reduced exhaust temperatures to 230° F. as well as adding considerably to the heat recovery ratio of the system.

The utilization of sewage gas in gas engines is entirely feasible with the "Vapor-Phase" system even if the gas contains the very corrosive H_2S. No scrubbers or purifiers are required inasmuch as the cooling system operates at temperatures well above the dew point of corrosive substances. Thus all harmful acids are carried out of the engine in vapor form. In addition, the steam generated can be utilized in heating the sludge digesters or other processing equipment.

In addition to increasing the thermal efficiency of internal combustion engines, "Vapor-Phase" is said to increase the mechanical efficiency also as much as five per cent and higher. The reason seems to be the higher operating temperatures which cut down friction losses.

TWO-CYCLE MA

RATED at 35 hp. and 60 hp. per cylinder for the 6¼ in. x 9 in. and the 8½ in. x 11½ in. respectively, the Model 31A is the latest addition to the line of Diesel engines manufactured by Fairbanks, Morse & Co.

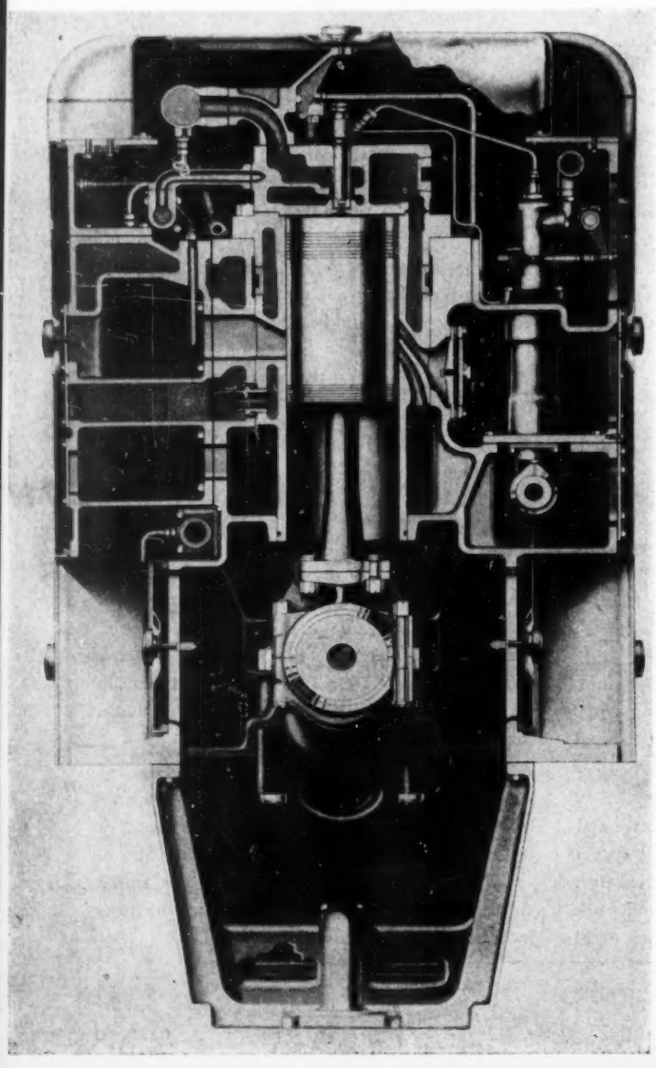
A brief announcement of the first of these engines was made in 1944 when it was installed in a "floating laboratory," and given a thorough test in several seasons of sea service. Regular production was also started at that time and numerous installations have since proven the excellence of the design. Construction details have not previously been released and it is therefore believed that a complete description of this engine is of considerable interest at this time.

In the Fairbanks-Morse Model 31 is embodied the experience gained by over a century of precision machinery building augmented by over 5,000,000 hp. of heavy duty Diesel engines.

One of the features of the Model 31 is its cylinder block which is a single casting, incorporating both crankshaft bearings and cylinder bores in the one piece so that proper alignment between the two is assured. Its depth and wall construction give rigidity without excessive weight. Large openings on both sides of the block afford easy accessibility to all main and connecting rod bearings. This one-piece cylinder block also serves as a mounting for all of the working parts including the cylinders, crankshaft, camshaft and injection pumps thus assuring proper relative alignment and position behind the various parts. Elimination of the possibility of hidden leaks and contamination of the lubricating oil by the cooling water is accomplished by the fact that there are no cored water or lubricating oil passages in the block.

The arrangement of the cylinder liners in the block permits free expansion at the lower end and the use of the integral water jacket avoids the necessity of a water seal at this point. The crankshaft is assembled in the lower part of the block and is held in place with bearing caps carefully fitted between heavy guides.

The engine is equipped with removable cylinder liners of the type used in other models of Fairbanks-Morse Diesels. These have the added advantage of integrally cast, leak-proof, water jackets. With the water confined in a single casting, leakage due to jointed construction is thus eliminated. It is cast of special close-grained iron of great tensile strength, and machined and honed to close tolerances, resulting in a perfect sealing of the combustion gases. All liners are interchangeable and the internal passages between cylinder liner jacket and cylinder head provide uniform distribution of cooling water.



Transverse section of the Model 31 F-M Marine Diesel showing fuel, lube and cooling systems.

The chief characteristic of the cylinder head proper is its unusual simplicity. There are no exhaust or intake valves; the heads are fully water cooled, with special attention given to cooling the portion of the head surrounding the injection nozzles. Furthermore, the head can be lifted without disturbing either the water or starting air manifolds.

The crankshaft in the Fairbanks-Morse Model 31 Diesel engine is of unique design. It is a one-piece casting from a high strength semi-steel alloy. Extra large main and connecting rod journals are used to provide rigidity of structure. This type of construction allows the use of hollow crank pin and main journals which result in increasing their strength with no increase in weight.

The wearing surfaces are machined to very close limits and the final grinding and lapping operations reduce the journals to their exact dimension, leaving a perfect bearing surface. The crankshaft is dynamically balanced in a special machine while being rotated at engine speed.

The steel connecting rods are die forged and are fitted at the upper end with a precision type bronze bushing so accurately fitted that the assembly requires no hand fitting or special machining. The crankpin bearing shells are also precision type, interchangeable top and bottom and also interchangeable with the main bearing shells. The bearings require no hand fitting and are easily and accurately assembled with no shims being used. The piston and connecting rod can be withdrawn without disturbing the crankpin bearing. This is accomplished by using two sets of bolts—one set to connect the rod to the bearing box and the other set to clamp the two bearing halves together. No compression shims are used at the connecting rod foot as this detail is made a part of the piston construction. The connecting rod bolts are readily accessible through the large openings on each side of the crankcase.

The camshaft is a drop forging, machined all over, with the cam profiles heat treated and hardened. Its construction is simple in that it carries only the integrally forged injection pump cams. It rotates in pressure-lubricated, precision type bearings which are supported by the cylinder block itself. Its location is close to the injection pumps. One central system provides oil under pressure for all parts in the engine requiring lubrication. A built-in lubricating oil pump delivers oil at controlled pressure to the manifold from which it is distributed as required.

The same system also provides for oil cooling the pistons. The cooling oil is forced up through a hollow connecting rod to the piston pin and thence into the crown of the piston itself. From this space the oil circulates down inside the piston, cooling the entire skirt, and is then ejected into the crankcase sump.

The piston is of the trunk type, made of close-grained cast iron. Its length is great in proportion to the diameter, thus reducing the side pressures and increasing the life of both the piston and cylinder. A special feature is that a separate, one piece piston pin bracket, securely bolted to the inside of the piston, permits a smooth unbroken external cylindrical wall.

Cylinder compression is adjusted by means of shims, between the piston pin bracket and piston. With precision bearings there is little need to change these shims. Their location eliminates the possibility of loss or improper assembly when pistons are removed.

Individual inivalve fuel injection pumps are used of the variable beginning type which automatically retards the timing at reduced speeds. The injection pumps located adjacent to each cylinder are

MARINE DIESEL BY FAIRBANKS-MORSE

connected to the injection nozzles by short, equal lengths of high pressure injection tubing. The pumps are operated by a camshaft. A built-in fuel oil pump of the position displacement gear type transfers fuel from the service tank to the injection pump manifold. A simplified injection nozzle with the needle sleeve and seat in one piece, supplies fuel to the cylinder. A primary filter is used in the low pressure fuel line, and in addition, each injection nozzle has its own built-in filter to give further protection.

Engine speed is controlled by a built-in hydraulic type governor with characteristics designed particularly for Marine service. A single lever controls the starting, stopping and reversing. No endwise movement of the camshaft is required. A small movement of the air start cam by a positive linkage is only change when reversing.

A balanced, oscillating type, positive displacement blower is built into the main cylinder block and is driven from the forward end of the crankshaft. This blower furnishes an abundance of air at the proper pressure to completely burn the full load fuel requirements with a clear exhaust and with a generous overload reserve. No reversing valves are necessary on the blower as its operation is identical regardless of engine rotation.

The scavenging air is admitted to the cylinder through a set of low-resistance, automatic leaf type valves, permitting the scavenging ports to be closed after the exhaust ports. This eliminates the effect of pressure surges in the exhaust pipe and at the same time makes the air pressure in the cylinder equal to the scavenging air pressure at the moment of port closing.

The exhaust manifold is fully enclosed and water-cooled. It is designed to conduct the burned gases efficiently away from the exhaust ports. The gas is moved through an unrestricted passage to a single exhaust outlet near the center of engine.

Cooling water enters the engine through the inlet to the exhaust manifold jacket and thence directly into the cylinder jackets, thus providing uniform distribution to each cylinder.

The unusual features of design include large inspection covers which are provided in the exhaust manifold so that the cylinder, liner, piston rings and the piston may be easily inspected through the exhaust ports.

A starting air valve in each cylinder head is controlled by means of a pilot air system. With this system "dead spots" are eliminated and maneuvering is fast and reliable. Changing from the "ahead" to the "astern" position on the starting system involves moving only one small cam. No air cylinders or similar devices are required and the action is positive.

The design of the engine also includes a built-in air compressor, single stage, which is water cooled and which utilizes the same drive as the scavenging blower. It has ample capacity for all normal maneuvering, even in tug-boat service, and is so located as to be readily accessible for piping.

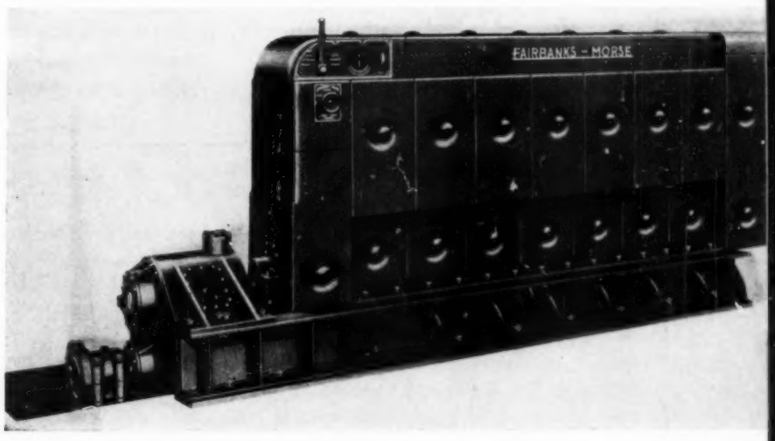
Other built-in engine auxiliaries available on the Model 31 Diesel engine include two identical reversible lubricating oil pumps (pressure and sump), two identical reversible centrifugal water pumps (jacket and raw water), a fuel oil pump, and a slow-speed reciprocating bilge pump.

One of the features claimed for the Model 31 Diesel is its unusual accessibility. A series of conveinently located openings on both sides of the engine allow plenty of room for inspection and servicing without dismantling the entire engine. A crankshaft extension is provided at the forward end of the Fairbanks-Morse Model 31 Marine engine for use in driving such additional equipment as an auxiliary generator, deck wash pumps, etc. In addition, a clutch drive is available except for the 7 and 8 cylinder 8½ x 11½ size, for driving a winch or other deck gear. An extra bearing located in the pump drive housing supports the shaft extension so that either torsional or side loads may be applied without fear of distortion. The reduction gear is in keeping with the heavy duty design of the other engine parts. The gear ratio is such as to allow the selection of the most efficient propeller. Both high and low speed shafts are of unusually generous proportions and are supported by large double row, spherical roller bearings on each side of the gears. A double cone Timken thrust bearing is provided on the low speed shaft. The gears are single helical type, cut from heat treated alloy steel.

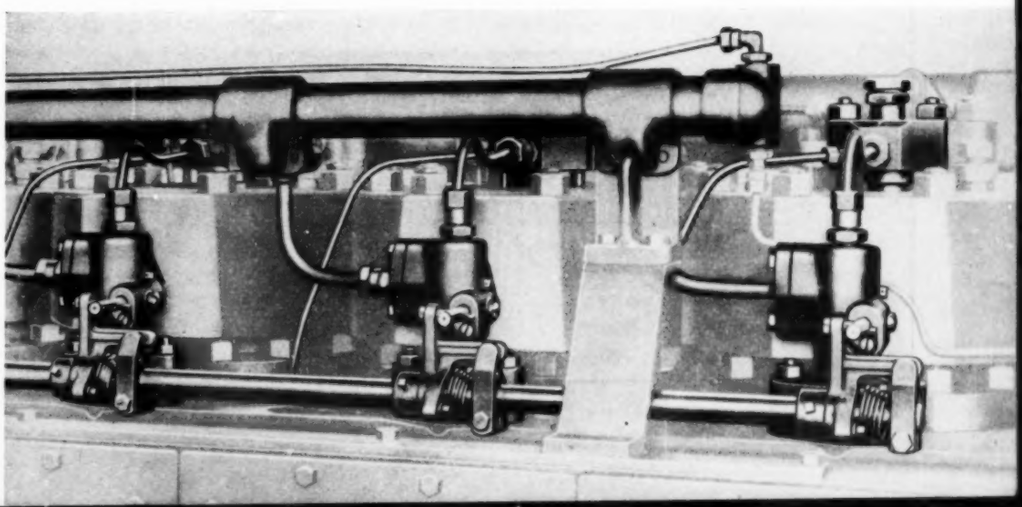
The reduction gear contains its own lubricating oil and a splash system provides copious lubrication to the bearings and gears. The gear case is water-cooled by the engine circulating water.

Alignment with the engine crankshaft is assured by bolting and dowelling the substantial gear case to the same base rails which support the engine. The low speed shaft is fitted with a coupling half.

The Model 31 Fairbanks-Morse Diesel engine is available for marine or mobile service in two cylinder sizes. The 6¼ in. x 9 in. has a rating of 35 hp. per cylinder at 720 rpm. The 8½ in. x 11½ in. engine is rated at 60 hp. per cylinder at 525 rpm. Both sizes are available in 5, 6, 7 and 8 cylinder units.



Operating side of F-M Model 31A6¼ Marine Diesel with reverse gear. New model is fully enclosed and streamlined.



Fuel system assembly showing fuel manifold, injector pumps and short, equal-length tubes to injection nozzles.

Great Lakes Diesel Cruiser

By DOUGLAS SHEARING

Luxury cruiser *Cappy* has an all-steel hull, is 67 ft. 3 in. l.o.a., 16 ft. wide and is powered with a pair of General Motors "71" Diesels.

Deck house is occupied by the main salon with luxurious appointments.

WHEN a Great Lakes shipping executive buys a Diesel yacht that's news, but when he incorporates her under the name of *Cappy* Inc. of Wilmington, Delaware, that's even better. Gene C. Hutchinson of Cleveland shipping fame named his new 67-footer after his father, the late Captain C. L. Hutchinson, whose nickname now graces the transom of the new boat.

The *Cappy* was built by the Burger Boat Company of Manitowoc, Wisconsin. She was designed by Philip L. Rhodes of New York. Both builder and architect contributed in making her one of the sleekest and most comfortable yachts on the inland waterways. She is 67 feet 3 inches overall, 64 feet 5 inches on water line. Her 16 foot beam and 4½ foot draft round out her vital statistics. She is of all-steel construction with 3/16 and ¼ inch hull plating. Her deck house is 10 and 12 gauge steel.

The *Cappy's* power plant consists of two General Motors Diesels driving through a pair of Twin Disc 2:1 reduction gears. The Diesels are rated at 165 hp. each. She carries 1000 gallons of fuel, enough to give her a cruising range of 1,200 miles. Auxiliary power is furnished by two Sheppard Diesels, a one cylinder 6 kva. and a two-cylinder 13½ kva. set. These auxiliary units carry a heavy power load which includes an electric range, Frigidaire, freezer, and lights as well as the auxiliary and navigating equipment.

The vessel is very roomy as her 16 foot beam will testify. The space above deck is occupied by the pilot house and deck house, the latter serving as the main salon. It is accessible from the pilot house and is quite spacious. It is finished in bleached mahogany paneling and is handsomely furnished with a table, buffet and chests as well as a built-in leather lounge. Just forward of the deckhouse on the lower level is the galley, completely electrified utilizing 110 volts A.C.

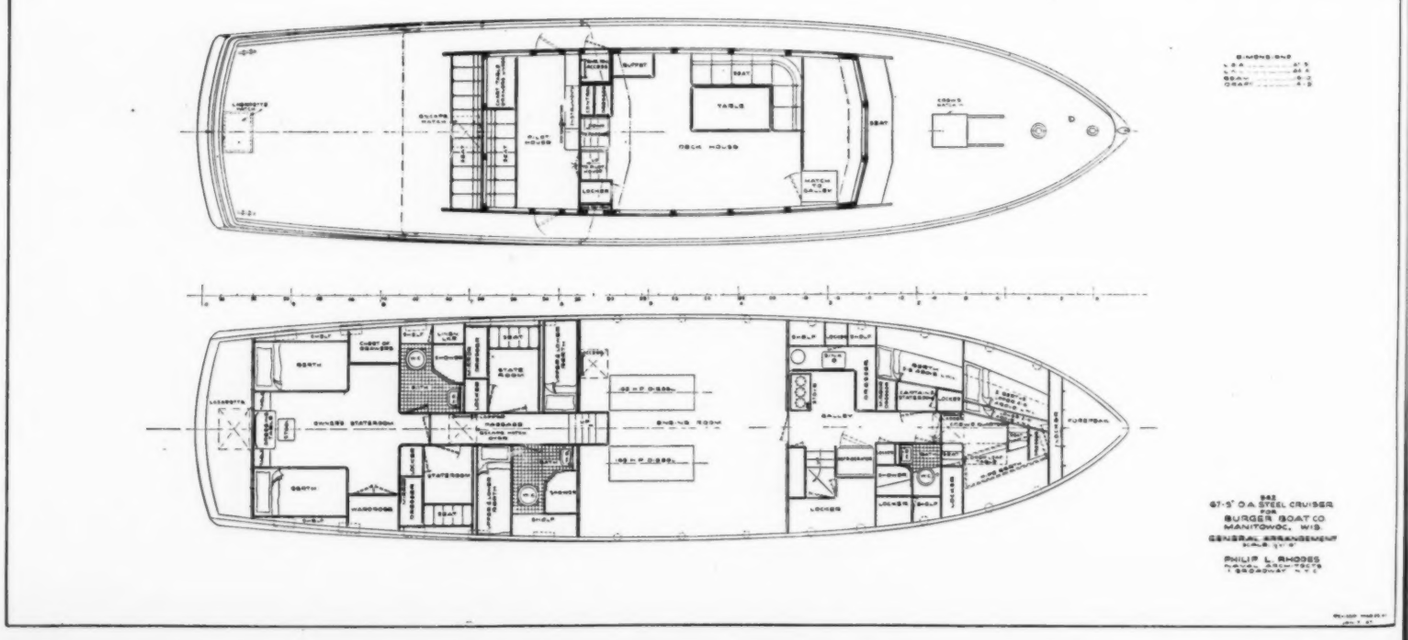
Forward of the galley is the captain's stateroom and the three man crew's quarters. These latter quarters are unused at present inasmuch as Captain Nelson is the only full time crew member. Captain Nelson recently retired, was formerly skipper of the *C. L. Hutchinson*, one of the Hutchinson line ships. The owners' quarters and guest staterooms are located aft, with the owners' quarters extending the width of the ship and having a private bath. The two guest cabins share the remaining bath. 500 watt electric heaters keep these quarters warm.

The pilot house is well equipped and has many of the devices found on much larger ships. A Bludworth direction finder, a 100 watt Western Electric ship to shore phone, a Sperry automatic pilot and Solenaud electric clutch controls round out this department.

Other auxiliary equipment aboard the *Cappy* includes Blackmer bilge pump, Burke water system, Portable Light Co. search light and an Ideal electric windlass with 1 hp. motor.

Inasmuch as her owner has incorporated the *Cappy* in Delaware, her home port of registry is Wilmington but one can be sure that her heart is in the fresh water lakes where she was built.

Below: General arrangement of the *Cappy*.



New Machining Methods Simplify Diesel Engine Manufacture

By E. K. MORGAN*

IMPROVED Diesel engine design and simplification of large engine components has brought about several new concepts of machining. This is largely the result of a combination of important factors arising from an urgent as well as unprecedented demand for Diesels as a power source.

To meet such conditions progressive engine builders are re-evaluating their production facilities. In many instances, it is found that much of the credit for the progress already made rightfully belongs to those engineers who have coordinated design and production plans to develop new ways and means of producing engine beds, frames, blocks, connecting rods, heads, crankshafts, yokes, blower housings, and similar other parts. Not only has production been a first consideration in this planning, but assembly of the finished parts is also treated with equal importance.

Ingenious new tooling ideas are constantly being developed to speed machining; improved work handling methods are devised to eliminate lost set-up time; multiple purpose machine tools are steadily replacing single purpose machines for individual operations.

As a result engine parts are being produced with greater accuracy. Specification requirements are held to closer limits, and machined fits vastly improved. With more and more attention being focused on the value of accurately machined components, engine assembly is automatically simplified and made easier. Granting that this general improvement in the Diesel field exists, it is readily understandable why these engines are establishing such remarkable performance records.

It must be realized that a new tooling idea does not necessarily mean a revolutionary departure from standard machining practices. In short, a new idea may merely be the use of existing equipment to better advantage. The idea in this instance would be a different approach, a short cut, say, to an ordinary machining problem.

An excellent example illustrating this particular point is that of milling a crankshaft bearing seat bore, see Figure I. With the exception of one large West Coast Diesel engine builder in whose plant this idea recently originated, most companies perform the operation by either boring or planing. In either instance, the engine base, if large, must be placed flat on the machine table. If the circular bearing seats are planed, considerable time is necessarily consumed in this method.

Assuming that bearing seats are bored in the conventional manner, the caps must be bolted in place to obtain matched fits. Then, before removing the caps, they must be properly marked to assist in final crankshaft assembly. When boring bearing seats, the operation is ordinarily performed in one of two ways. They may be bored *individually* or *simultaneously*, depending upon the type of boring bar available.

If bearings are bored one at a time, a single fly cutter type tool is used. In this procedure, it is necessary to remove the tool after each bore is completed. The cutter is then placed in a different slot in the bar to correspond to the succeeding bore. Resetting the tool each time not only requires valuable productive time, but also increases the possibility of error because of repeated settings. In addition, an internal type support must be used to steady the bar. A bore may be bushed in this case, or a simple internal support fixture used. Both, however, require added set-up time.

Bearing seats may be bored simultaneously on smaller type engines. Should this practice be followed, a special type boring bar is required. Cutter slots may be properly spaced in relation to the bearings, and a separate block type cutter placed in each of these slots. When this work is handled on a horizontal boring machine, the operator places the cutter block in the bar before engaging the machine feed to complete the bore.

Still another method exists for simultaneously boring bearing seats. This method is similar to boring with block type tools but is accomplished with expanding and retracting type cutters, mounted in a special Davis boring bar. When this type of bar is used, it is necessary to mount the bearing caps in place, and also to bolt to the end of the engine case or block, a stop fixture which activates the internal mechanism. This, in turn, expands and retracts the cutters as they are fed through the work—refer to Figure II.

Each of these methods has its particular advantages and disadvantages; through comparison, the progressive manufacturer will readily see how a new tooling idea, such as milling the crankshaft bearing seat bore, can improve production, especially on large engines.

Exploring this new tooling idea further, it is found that the engine base is mounted on the machine table in a vertical position rather than horizontally. The crankshaft bore is now at right angles to the machine spindle. Through the use of a simple angular milling attachment on any standard type horizontal boring machine, it is possible to mill all bearing seats in a single work setting. This method of boring requires a milling cutter of the same diameter as the bore.

Work is rapidly and accurately positioned in relation to the cutter by engaging the machine feeds. As one bearing bore is finished, the machine table or column is moved to the second bore and so on until the entire boring operation is completed. Alignment of the bores in this case depends entirely upon the traversing accuracy of the machine.

Required speeds and feeds are easily obtained. To

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* *Vice President in Charge of Sales, Giddings and Lewis Machine Tool Co.*

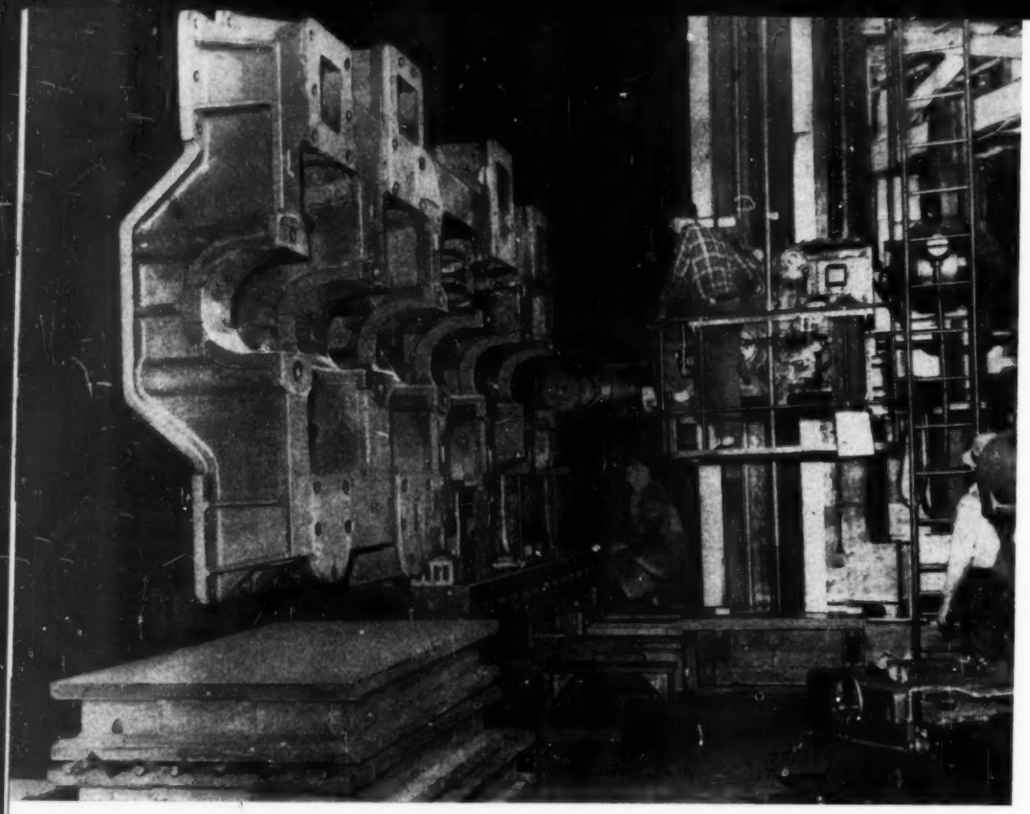


Fig. I. Above milling crankshaft bearing seat bores on a horizontal boring, drilling and milling machine. An angular milling attachment is used.

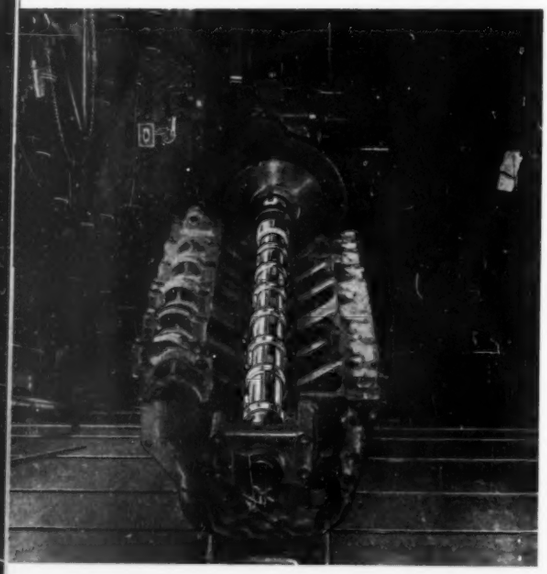


Fig. II. (left) Caps will be bolted in position and all crank bearings bored simultaneously. Expanding retracting type cutters are used. Stop block is bolted to end of engine block to activate cutters.

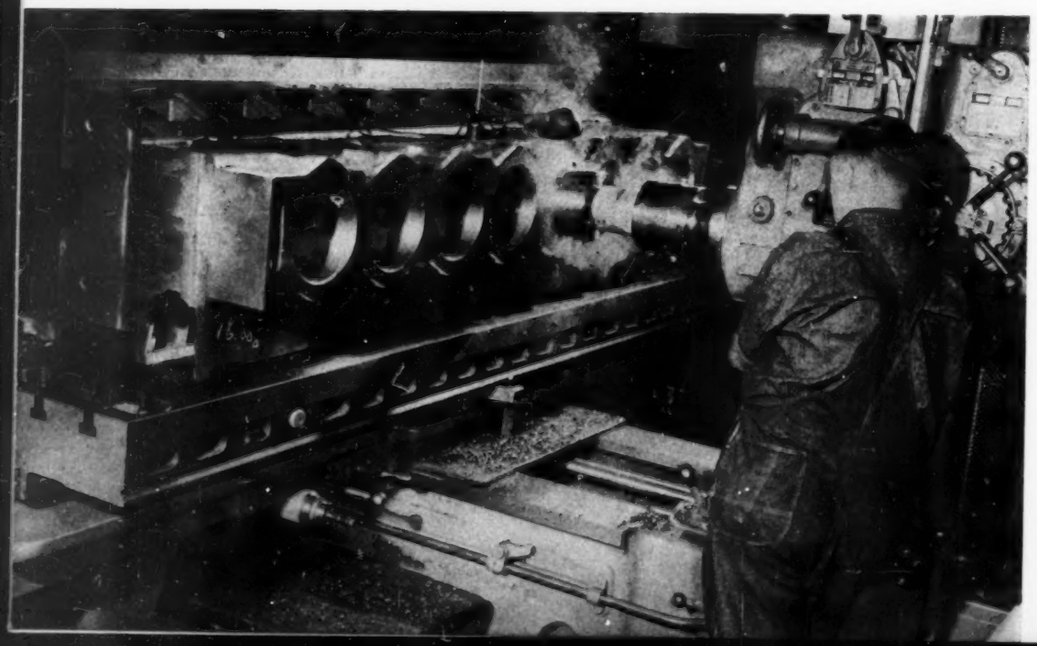


Fig. III. (below) Boring cylinder liner seats with a special cutter head. Machine has adequate power to make machining cuts simultaneously.

present the work to the cutter, the table feed is used on table and planer type machines, while column traverse is engaged to feed the cutter on floor type machines.

Milling the crankshaft bearing bore as outlined has definite advantages. It is possible to turn or mill the bearing caps on another machine tool, and the accuracy of the overall operation is such that caps become interchangeable. As a result they do not have to be marked for subsequent assembly.

In those instances where it is necessary to face mill bearing cheek pads, this machining operation can be easily accomplished in the same work set-up and using the same tooling arrangement. The milling cutter is quickly positioned by raising or lowering the machine headstock. Table or column feed is engaged for cut depth. For example, all right sides of pads are milled with the angular milling head in the correct position. When this operation is completed, the milling head is turned 180° and the left sides of the pads are milled.

Ingenious tooling ideas are not limited to any single machining operation. This is clearly indicated by the procedure followed in boring cylinder liner seats illustrated in Figure III. With a special type boring head, seven individual machining cuts are made in a single pass of the tool. These include rough and finish boring the lower liner seat and forming the oil ring gasket groove. The upper liner seat is rough and finish bored, counterbored and chamfered.

An interesting comparison can be made in the floor-to-floor time required for this particular job. Only a single set-up is necessary to mount the eight cylinder block on the machine table; and this takes but one and a half to two hours. In the machining method previously followed on this job, two set-ups were required because of limited machine capacity.

Now all eight upper and lower liner seats are finish machined in approximately two hours as compared to an original time of sixteen to seventeen hours. Overall or floor-to-floor time has actually been reduced from two full working days to four hours.

The simplicity with which this work is completed emphasizes the importance of taking full advantage of a horizontal boring machine's flexiiblity, as well as the numerous time-saving tools and attachments available to improve work quality and production output.

In these brief examples, it has been shown that ingenious new tooling ideas for machining Diesel engine components are far from exhausted. Consider now how the open construction of horizontal boring machines offers short cuts to work handling methods.

Many engine components present unusual han-

dling problems because of their size, shape and weight. In fact, the method of mounting such work on the machine may easily be the determining factor in establishing the total manufacturing cost of that particular part. Too often, the engine builder is limited by the working capacity of a single purpose machine tool, and as a consequence must use several such machines to complete the required operations. Obviously, changing the work from one machine to another increases handling time and sharply raises production costs.

Thus to simplify routing of work that is large, clumsy and unwieldy, many Diesel manufacturers are turning more and more to "open construction" type metal working tools. The horizontal boring machine best typifies this class of equipment.

In this machine there are no interfering columns, brackets, supports or overhead structures to hinder work set-up; the largest part designed (factory space permitting) can be extended in any plane regardless of its length, width or height. Open structure permits placing a frame, bed, block, manifold, base, crankshaft *or even a complete engine* on the machine. However, this should be considered only as a single step in the manufacturing process. The important point rests in the horizontal boring machine's design, which makes it possible to complete any type of set-up quickly.

This machine offers practically unlimited possibilities for conveniently mounting work for milling, boring, reaming, turning, facing and all similar machining operations. It is worthwhile now to observe how one engine builder places two blocks on a machine table to perform a *series* of milling operations. Dual set-ups reduce handling time and permit unusual accuracy in machining both blocks, for it is unnecessary to repeat the same cutter setting for each block.

Another progressive method of work handling is shown in Fig. IV. This large crankshaft, together with workholding fixture, is mounted on box type parallels which are securely bolted to the machine floor plates. After the crankshaft is mounted, it is then indexed in the holding fixture. Rotating the work rapidly presents the throw surfaces to the cutter for milling. This method of handling, together with machining, makes it possible to mill all crankshaft throws in six to seven hours.

A unique set-up is illustrated in Figure V. This shows how a drilling operation is performed in a crankshaft coupling flange without removing the crank from the engine. Thus, if specifications are suddenly changed, or a hole is forgotten in critical work, it is apparent how the horizontal boring machine becomes an extremely valuable asset in the manufacturing plant.

A third essential in the profitable production of Diesel engines is having a single machine capable of performing a broad range of work on different parts. The horizontal boring, drilling and milling machine belongs in this classification.

Adaptability of the horizontal boring machine for a variety of operations has already been indicated in the example discussed. However, the full work potential of this machine is often overlooked, for it is difficult to immediately visualize all of the possible movements and combinations of movements of work and tool.

Fundamentally, there are three characteristic feed motions—longitudinal, lateral and vertical. A fourth movement, rotative, is obtained with either a vertical or a horizontal rotary table. Consequently these movements and their combination permit a broad range of machining possibilities which make it practical to duplicate with one multiple purpose machine those operations ordinarily performed on several single purpose tools. The horizontal boring machine will efficiently bore, drill, ream, tap, backbore, counterbore, face .turn, saw and form many production parts.

Specifically, milling of Diesel engine components proves considerably more advantageous than planing or shaping from the standpoint of time saved and finish produced. Also, without resetting the work, milling operations performed on this machine are readily followed by boring, drilling, tapping, facing or any similar operation or series of operations. Thus, when an engine block is placed on a rotary table, all four sides are rough and finish milled by indexing the table to position each side of the work. After this work is completed, cutters are quickly changed for drilling and tapping cover plate bolt holes, or for boring camshaft bearing holes. To assure complete accuracy in these various operations, machine scales and verniers are used to locate all dimensions and to spot all holes.

It is recognized that indiivdual machining problems are sometimes more complex than the examples of work already described. When unusual or complicated machining work arises because of engine design or assembly requirements, there is usually a practical way to complete such work on the horizontal boring machine. In such cases, time saving accessories and attachments are often employed. These include angular milling attachments that machine hard-to-reach surfaces; continuous feed facing heads, that bore, turn, face and recess; over-arm type arbor supports, used extensively for multiple milling operations; duplicating attachments for machining contours; and, of course, the rotary tables which have already been mentioned. All add to the flexibility and productivity of the horizontal boring machine.

Only a few of the progressive machining practices of several companies have been outlined. Performance facts have been selected to indicate the broad work range of a general purpose machine tool. When the horizontal boring machine is not at work on the jobs shown, its productive time is profitably employed on run-of-the-shop machining operations in general service.

Fig. IV. Box type parallels and holding fixture reduce set-up and machining time in milling crankshaft throws. Single set-up requires 25 minutes, crankshaft throws can be milled in 7 hours.

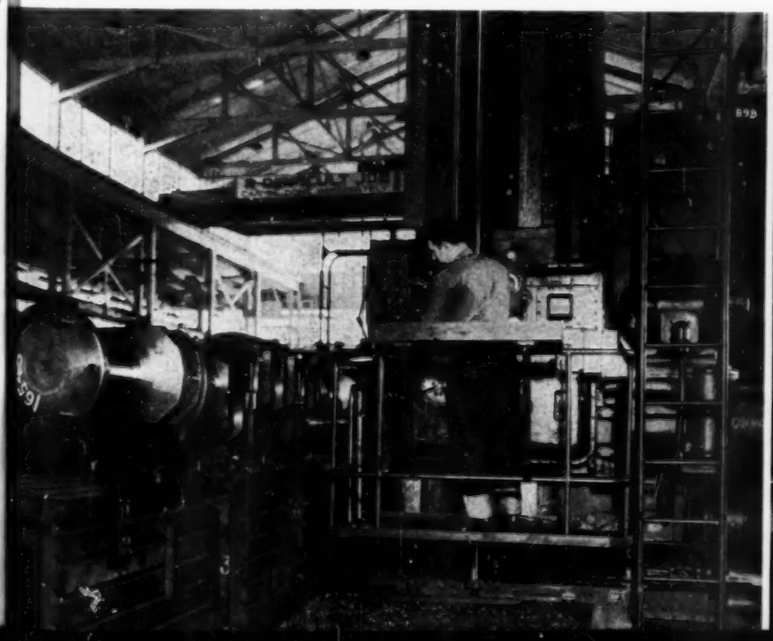
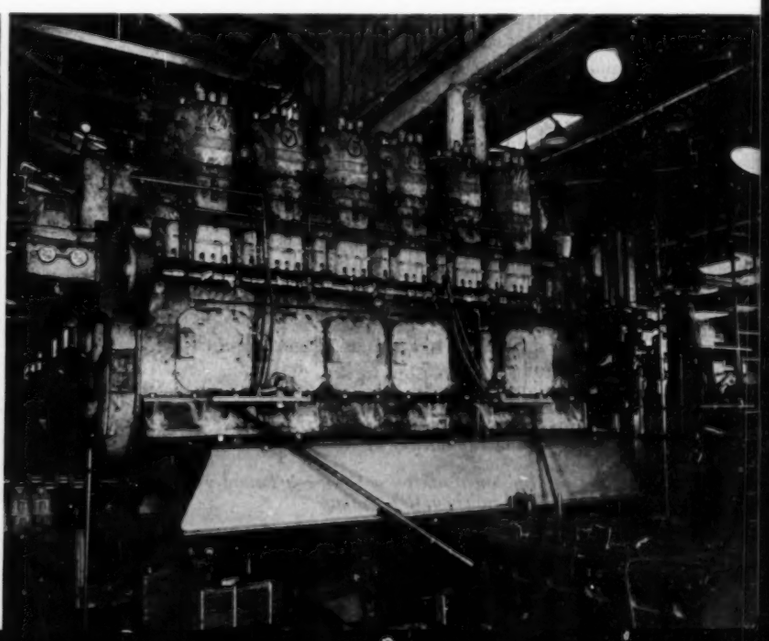


Fig. V. An unusual work set-up made in order to drill the crankshaft flange without disassembling the engine. Open machine structure permits work extension in any plane.



RECENT AND FUTURE DEVELOPMENTS IN DIESEL ENGINES*

By SAUL BELILOVE**

THE Diesel engine is, as our British friends call it, a compression ignition engine in contrast to the spark ignition engine which uses gasoline as fuel. The compression ignition engine has had an increasing demand since the date of its discovery back in the 1890's. At first its uses were confined to stationary applications, then expanded to marine applications. Later, with development of the engine to lower weight and size per horsepower, automotive and railroad engines became more popular. At the present time Diesels are being used for marine and stationary applications up as high as 10,000 hp. The railroad Diesel unit is supplanting the steam engine locomotive almost completely, and in the automotive field, the Diesel engine is becoming increasingly popular for all types of heavy duty road equipment. Probably the best indication of present Diesel popularity is the fact that the United States is now producing about 35 million hp. of Diesels per year compared with only about 2 million hp. only ten years ago.

However, it is unfortunately true that the Diesel engine in America has continued to borrow its ideas from Europe. Almost every recent Diesel development in this country was absorbed from Europe where the basic research was done. In the Diesel field, just like many other fields, the United States has supplied the application rather than the research. Developments such as gas-oil operation, exhaust driven superchargers, opposed piston design, and many others, exceedingly important to our present Diesel industry, are examples of borrowed principles.

Recent major trends in Diesel development are (1) higher speeds for all types of applications despite the fact that the top speed limit of Diesel engines has not changed particularly in the last 10 years, (2) a huge increase in production and therefore a large decrease in relative first cost, and (3) design developments which have considerably increased the loading of engines very appreciably. Probably the greatest gain in the last decade has been made in loading increases. This applies both to 2 cycle engines where improved scavenging and greater supercharging have been the cause, and also in the 4 cycle engine where the exhaust turbocharger has been of tremendous importance in engines greater than 400 hp. in size.

* *Talk presented at meeting of the Northern California Section of the Society of Automotive Engineers.*

** *Engine Division, Enterprise Engine & Foundry Company, San Francisco, California.*

Developments in Diesel engines can be broken down into two major categories. One is design and the other is application. First I would like to discuss developments in the field of design.

One continuing conflict over the years has been the controversy between the two stroke cycle and the four stroke cycle. Abstractly, the two cycle engine appears the better, but engineers do not build Diesel engines in the air, so to speak. The four cycle engine has had many advantages which, coupled with the introduction of the exhaust gas turbocharger to four cycle engines a few years ago, has placed the four cycle engine in a superior position in an appreciable range of powers.

Another way in which engine design development proceeds is with respect to speed. Although peak operating speeds have not increased in the last 10 years—being a maximum of about 2000 rpm.—much headway has been made in increasing the reliability and decreasing the maintenance of engines running at speeds below the peak. Engines are being applied at higher revolutions per minute and greater piston speeds for the same uses than in times past. This has been a result of improvement in combustion and an improvement in materials generally.

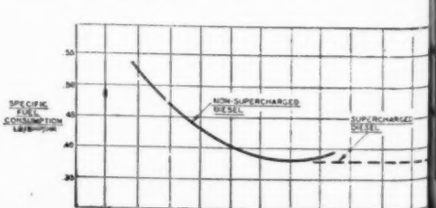
Maintenance, of course, is basically a design problem. Thus, the same improvements which help to allow increased loading and increased speed, also help to decrease maintenance. For example, improvement in bearing materials, valve springs, connecting rod bolt materials, fuel injection parts, lubricating oils, all help decrease maintenance costs and improve engine reliability as well as allowing higher loads and speeds. We have also learned enough about engine operation to insist upon better operating conditions in order to decrease maintenance. The use of filters—air, fuel, and lubricating oil—have contributed considerably to that end. Also, the use of higher jacket water temperatures has been of considerable assistance in assisting complete combustion and minimizing cylinder wear.

Let us now take a look at efficiency. The most significant advantage of the Diesel engine lies in the fact that it is the most efficient heat engine known. In fact, the slow speed Diesel engine can actually achieve a thermal efficiency of 40%. The reason for this is simply its high expansion ratio which results from its cycle of operation, therefore allowing considerably greater efficiencies to be attained than from the relatively low expansion ratio gasoline engine.

One method that has shown some thermal efficien increase in the past few years is that of increase engine loading. This is simply the result of i creasing the mechanical efficiency of the engi by decreasing the relatively fixed friction lo percentage of the total load. As a result, fo cycle supercharged engines and two cycle supe charged engines show somewhat higher therm efficiencies than their unsupercharged counterpar

Another way to improve efficiency is to use ne methods which have resulted from a shift in o thinking. Rather than considering the Diesel e gine as strictly a machine for converting the chem cal energy in the fuel to mechanical energy in t shaft, we might also consider the production heat energy as well. By considering the enti needs of the power plant, we may learn how provide a balanced overall arrangement whic utilizes what is now considered waste as an integr by-product of the energy output. Thus, eve though the thermal efficiency of the engine itse may not be any greater then 35-40%, it is st possible that the heat rejected to the jacket wat and to the exhaust gases may be useful either f space heating or to operate low pressure boile for process steam or other purposes. It is of cour clear that the relatively low temperatures availabl from most exhaust gas and jacket water cooli systems are not particularly valuable to obta mechanical work since we must go through a other inefficient thermal conversion. But for spa heating, for process steam and for other mi cellaneous services, this heat has considerabl value. As a result, depending upon the way w look upon the problem, we may consider that t overall utilization of the energy within the fu can be as high as 75% in some plants.

It is interesting to note a new development whi has recently arisen. This is the idea of raising t available heat in the jacket water cooling syste by raising the temperature of the jacket wate Up to a few years ago any temperatures in t jacket water of a Diesel engine above 125° F. we considered "dangerous." But a few years ago te peratures up to 160° and even 180° F. becam



TYPICAL DIESEL ENGINE VARIATION OF SPECIFIC FUEL CONSUMPTION WITH LOAD

fully acceptable. Now, the "Vapor Phase" idea is to use jacket water under pressure at temperatures as high as 280° and perhaps 250° F. One strange result is that many engines without any design change whatsoever, operate very well on these high jacket temperatures, and there seems to be no reason whatsoever why all engines, although some may perhaps require modification, cannot be operated at these high temperatures. Naturally, the availability of the heat in the jacket water system increases tremendously, and there are certain improvements in engine maintenance as well.

Recent developments have allowed us to increase the average brake mean effective pressure of the Diesel engine from approximately 80 psi. in four cycle non-supercharged engines, to approximately 120 psi. in four cycle, supercharged engines, a gain of approximately 50%. This latter figure is being utilized in countless applications today. For the two-cycle engine, continuous mean effective pressures of over 80 psi. are being utilized compared with the 60-70 psi. of the past. These figures are today's established values. There is considerable evidence to indicate that considerably higher loadings for four cycle engines can be obtained, perhaps as much as 20-25% additional, in the near future. Indeed, for one application where peak power is required only intermittently, one engine manufacturer rates his engine at 150 psi. brake mean effective pressure.

Let us now look into the method of supercharging itself. Originally supercharging of engines was obtained by independent or mechanically driven superchargers of the positive displacement type, which absorb an appreciable amount of the engine output power. However, some ten years ago there was introduced in this country a new Swiss development—the Buchi system—which utilizes the heat and velocity of the exhaust gases for driving the supercharger of four cycle engines.

Not only does this Buchi system use an exhaust turbine to drive a supercharging blower, but also overlaps the intake and exhaust valve openings so that fresh air is forced through the combustion chamber to drive out the residual hot exhaust gases. This process considerably reduces the average cylinder temperatures. The Buchi system not only allows loadings to increase by approximately 50% with little increase in cost, weight, and size, but also has decreased fuel consumption, particularly at partial loads.

The 2 cycle engine is susceptible to exhaust supercharging also, but this has not yet been done in this country, although European concerns have been successful with this development.

A further new development which is very recent includes even higher supercharging pressures than used by the Buchi system. Actually the supercharging pressures used with the Buchi system are rarely more than 6 psi. With this new system, however, there is used even higher charging pressures—up to 15 psi.—which make available a greater weight of oxygen so that a greater quantity of fuel can be burned. Two problems result: The first is a large increase in peak pressures. The second problem is that of heat dissipation and increased engine resistance that is required. For these reasons, the maximum continuous loading with this system is not appreciably above that with the Buchi system—except that higher peak loadings for a short time are obtainable.

Loading Limits

Well then, what is the limit to Diesel engine loading. Unfortunately, there is no single one. But I can tell you present thinking about the factors which tend to limit engine loading. One factor is smoke. Smoke tells us that the fuel we are injecting is not all being burned—which fact is, of course, unfavorable for many reasons. But with supercharging, we have so far been able to get enough air into the engine to keep away from smoke formation.

Another way of limiting engine loading is by measuring the carbon dioxide in the exhaust. Another method is to measure exhaust temperature, that is the average temperature of the exhaust gases leaving the cylinder. This criterion, too, is of some value, but is of doubtful significance in two cycle and four cycle supercharged engines.

What we are faced with is the problem of how much heat we can liberate in a given cylinder in a given time without running beyond the limitation where the pistons will operate satisfactorily. It is this temperature problem that is the present barrier. In this connection, recent developments have been of assistance in increasing the heat resistance of the engine. One major factor is the development of heavy duty lubricating oils which keep carbon contaminants dispersed in the lubricating oil. A second major factor is the use of oil cooled pistons which help to dissipate the heat which is radiated and conducted from the combustion gases into the piston.

Other important improvements are piston rings which are now often chrome plated, chrome plating of cylinder liners, and aircraft type alloyed exhaust valves. It has been these developments that have allowed engine loadings to be continuously increased.

There have been some interesting suggestions regarding decreasing the heat load. Calculations show clearly that the intake air temperature is a major factor in the average gas temperature of the cycle. Even with the conventional Buchi system, the use of a simple cooler will decrease intake air temperature sufficiently to allow loadings to increase appreciably, perhaps as much as 20 to 30% in addition to the standard increase of the Buchi system. Thus, the total increase in loadings over a non-supercharged engine can be as much as approximately 75%. Moreover, for high pressure supercharging, the heat generated in compressing the intake air in the supercharger becomes even greater than in the Buchi system, and the use of an intercooler is even more desirable.

In general, heat engines offer thermal efficiencies which are proportional to the range of temperatures through which they operate. The higher the peak temperature, therefore, the higher the thermal efficiency. The advantage of the reciprocating engine is that the peak temperature occurs for only a small fraction of the operating cycle during that time when the piston is at its innermost position. Lower temperatures prevail during the rest of the cycle. As a result, reciprocating engines can and do obtain high efficiencies.

In contrast, we may consider the steam or gas turbine where many of the working parts are subjected to the peak operating temperatures, continuously during the cycle. As a result, peak temperatures for turbine type equipment are strictly limited although the possible exhaust temperatures are considerably lower than those that are obtainable with the reciprocating type engine.

A "marriage" between the two, therefore, seems particularly advantageous. With a system of this kind both the Diesel and the turbine can be geared to the output, working shaft, or the Diesel might be used purely as a compressor and feeder of high temperature gas to the turbine, with the turbine putting forth all of the mechanical work. It appears that arrangements of this kind, because they more greatly utilize the heat available in the exhaust gases, can offer thermal efficiencies between 40 and 50%.

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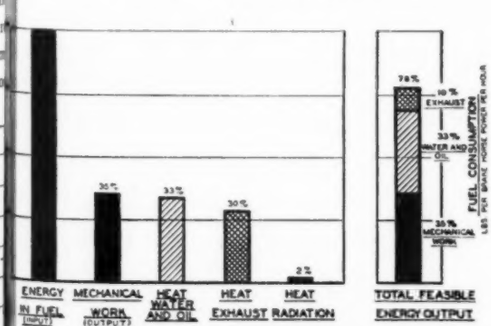
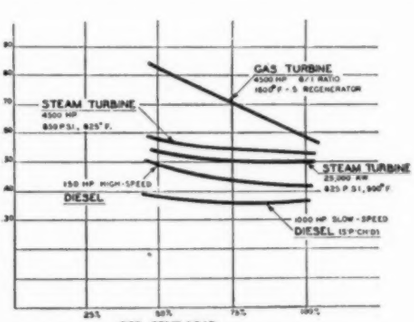


DISTRIBUTION OF ENERGY IN TYPICAL DIESEL ENGINE



FUEL CONSUMPTION VARIOUS TYPES HEAT ENGINES

HAND-IN-HAND . . .

SINCLAIR GASCON OIL

By reason of basic characteristics of the crude and built-in qualities GASCON OIL has u usual ability to keep engine interiors clean and also to clear away accumulated deposi

Oils that permit hard carbon to accumulate cause stuck rings an clogged parts, necessitating engine tear down...adding to main tenance expense and forcing loss of operating time. Reports repeatedl received from users of GASCON over the years show that carbon de posits are kept down with resulting low maintenance costs. May w advise on application of GASCON OILS to your lubrication problems

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DIESELS MODERNIZE 80-YEAR-OLD FERRY SERVICE

By KENNETH E. KEENE

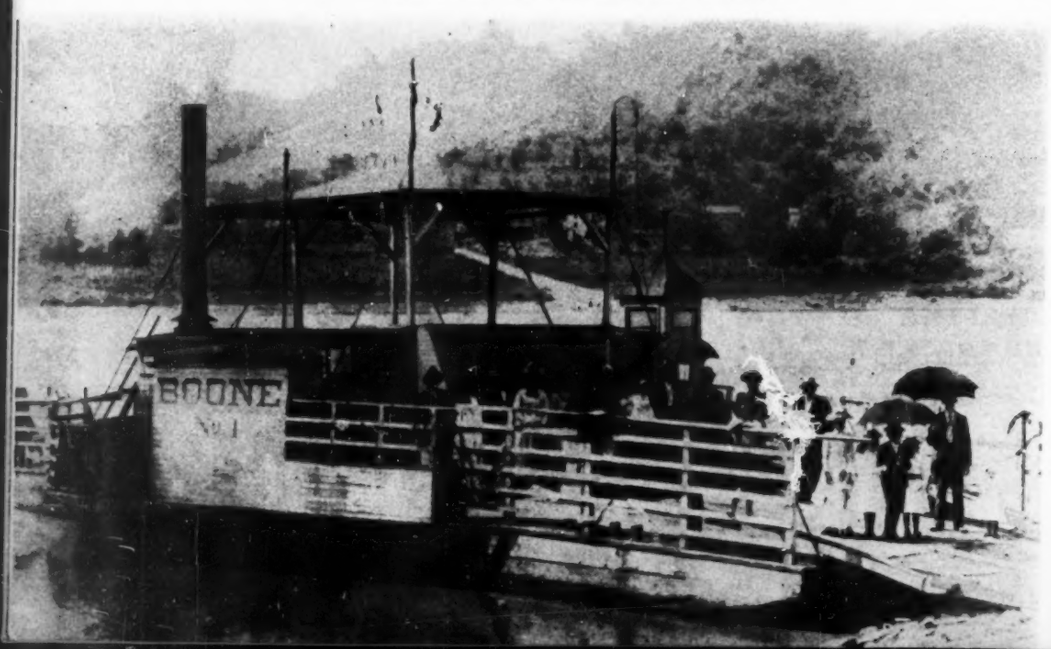
The Anderson Ferry, "Boone No. 7," was recently modernized with a Cummins Diesel. This ferry service at Constance, Kentucky has been operated by the Kottmyer family for 83 years.

IN 1864, while the Civil War was in progress, a stage coach operator named Charles Kottmyer purchased the Anderson Ferry, which plied the Ohio River almost within sight of the growing city of Cincinnati. Kottmyer drove his team of horses onto the ferry and placed them on the treadmills which drove the ferry's paddle wheels.

Today, Charles Kottmyers' great-grandsons are still operating the Anderson Ferry. But today's owners have a completely modern boat. The Anderson Ferry, as it carries passengers and automobiles across the broad Ohio at Constance, Ky., now is powered with a recently installed Cummins Diesel-electric plant. Instead of a two-horsepower operation, the ferry now derives its power from an engine capable of producing 150 hp.

In the years since Charles Kottmyer purchased the ferry from George Anderson, the family has followed the trends of transportation. First they replaced a treadmill-operated ferry with a steam plant. Finally, in May, 1947, the present owners, Oliver and Henry Kottmyer, turned to the most modern type of power to propel their present boat, *Boone Number 7*.

One of a long line of Anderson Ferries, the Boone No. 4 plied the Ohio River from 1884 to 1889. Steam powered she could do 10 knots.



A Cummins Diesel engine was installed in the boat to drive a 75 kw. Crocker-Wheeler 220 volt DC generator. The generator turning at 1200 rpm., supplies power to two 25 hp. Crocker-Wheeler motors which turn at 750 rpm. Each of the electric motors turns a side paddle wheel through a Falk 7HA herringbone reduction gear with a ratio of 7.5:1. By means of sprockets and chains the speed is reduced to 40 rpm. at the paddle wheels, giving an 18 knot speed.

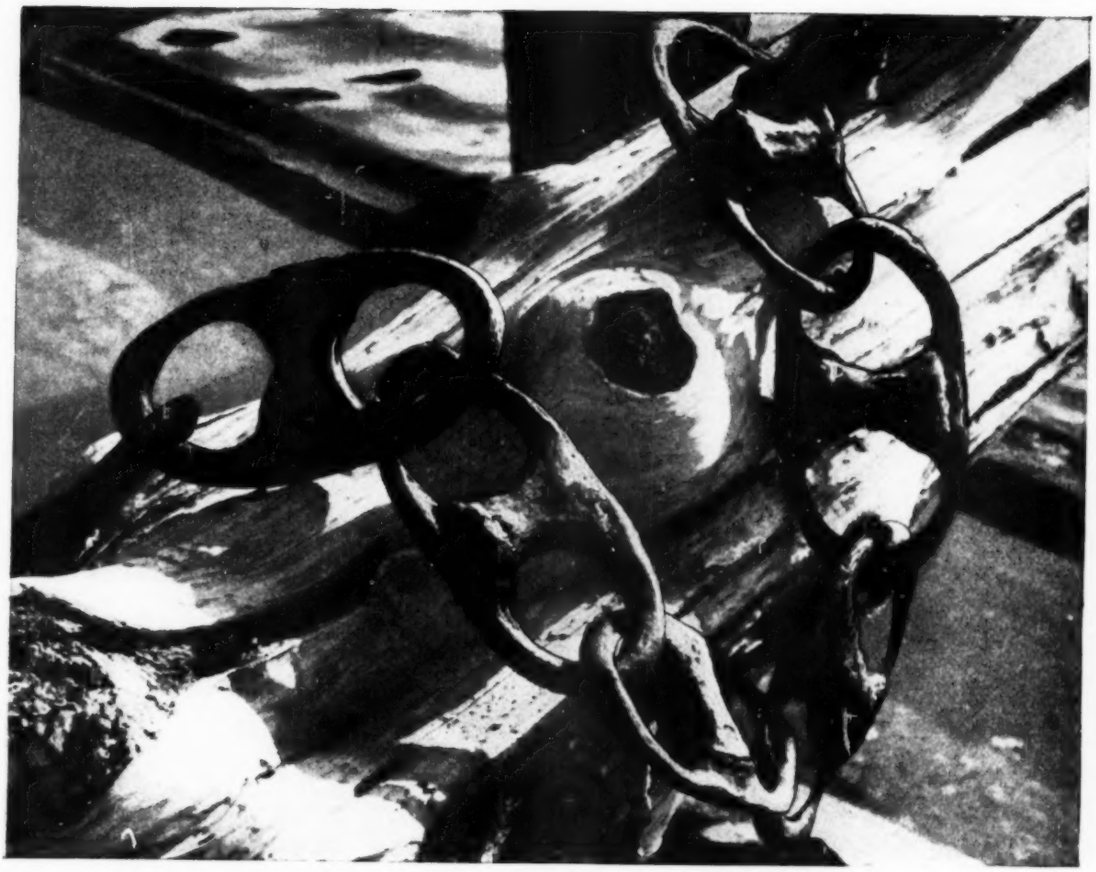
The Cummins Diesel engine replaced a 50 hp non-condensing steam engine, which had come from the present ferry's wooden-hulled predecessor, *Boone Number 6*. When *Boone Number 7* was built at Covington, Ky., in July, 1937, it was the first steel-hull ferry boat on the Ohio. The paddles of this double-end, side-wheel ferry are 16 inches wide by 78 inches in length. Eleven paddles are mounted on each of the two eight-foot wheels.

The Kottmyer brothers operate *Boone Number 7* seven days a week from 6 a.m. to 9 p.m., making upwards of 50 trips per day. The Cummins Diesel uses approximately 150 gallons of fuel oil per week, operating 15 hours a day. Weighing 58 tons and carrying eight automobiles per trip, *Boone Number 7* maintains an average speed of between 18 and 20 knots.

Oliver Kottmyer points to the fact that the Cummins Diesel enables the ferry to make more trips than the steam engine which it replaced. "This Cummins Diesel-electric set-up has cut our engine operating time in half," he says. "We are averaging three and one-half minutes for each trip now because we can pick up speed so rapidly."

Installation of the Cummins Diesel also made possible a three-inch reduction in the draft of the ferry boat, the Kottmyer brothers report. From horse-operated tread-mills in 1864 to a Diesel automobile ferry, the Kottmyer family has spanned the entire range of river transportation.

Location of the Greater Cincinnati Airport only one and one-half miles from their landing gives promise of increased business for their modern Ohio River ferry.



CHAIN REACTION

VERY OFTEN a single industrial lubrication problem in your plant, if allowed to run unchecked, can set off a whole chain of costly production hold-ups.

Rust or corrosion, for example, frequently unnoticed in its insidious early stages, may soon affect a vital piece of equipment or machine. Then, suddenly, an entire production line is thrown out of balance.

Furnishing expert counsel and advice on rust and corrosion problems is only one of the many ways Cities Service lubrication engineers can help you. These cost-conscious, production-minded experts are "professional worriers." Their recommendations for exactly the right grade of oils, greases, solvents or other petroleum products to meet your individual needs are based upon a sound, intelligent "situation analysis" made on the spot and backed by experience.

Moreover, behind the recommendations of a Cities Service lubrication engineer is the solid background of a company whose roots go back almost to the beginnings of the petroleum industry.

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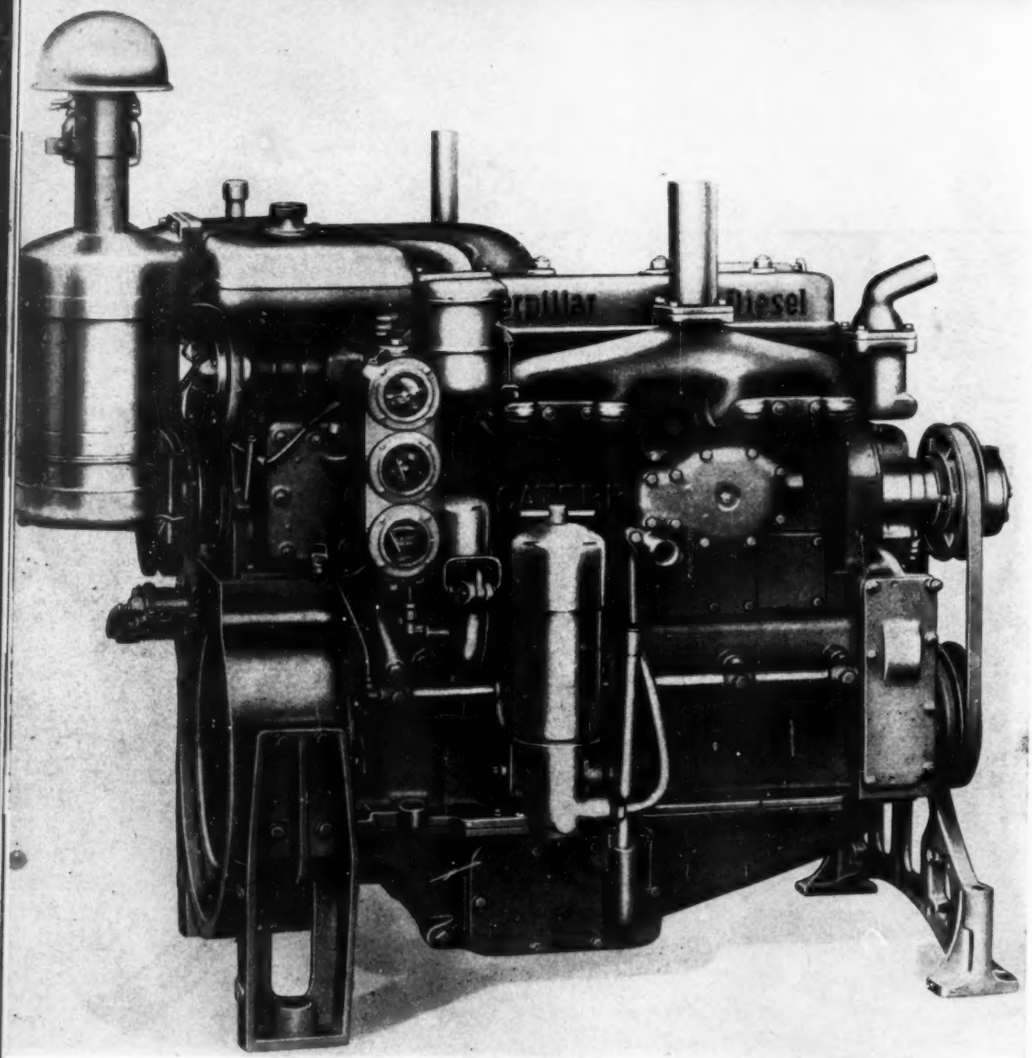


NEW CATERPILLAR DIESEL

CATERPILLAR Tractor Company has introduced a new Diesel engine, the four-cylinder "Caterpillar" Diesel D311. Embodying the results of several years of research in design changes and improved materials, the new engine offers a marked power increase to users, without increase in size or weight over the D3400 engine which it replaces.

Engineering and manufacturing refinements in the new engine give it a maximum output of 49 hp. with radiator fan and full equipment. The D311 is a four-stroke cycle design with a bore and stroke of 4 in. x 5 in. New manifold and exhaust and inlet passages are streamlined for smooth passage of exhaust gas and inlet air.

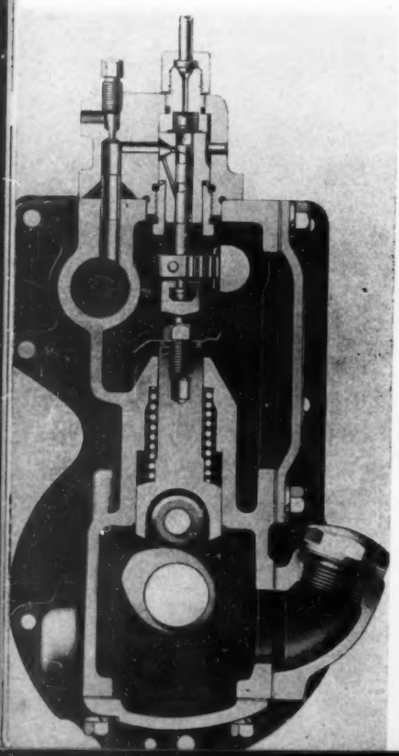
The fuel injection valves are of new and simplified design. Gear-type transfer pump supplies fuel through replaceable absorbent filters to individual fuel injection pumps. These pumps deliver fuel under pressure to single orifice fuel injection valves. The pressure-operated spray valve mechanism is completely calibrated at the factory and is enclosed in a metal capsule which is interchangeable as a unit. The system is designed for optimum performance over a wide speed range and has good characteristics at low idle speed as well as maximum performance at full load speed.

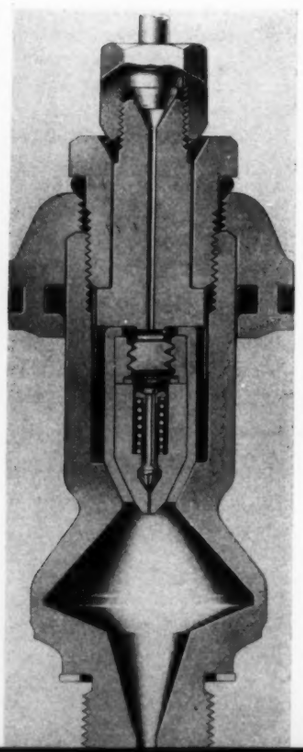
The oil cooled pistons are of a composite construction; aluminum alloy body and head with a cast iron band for the top ring groove. The top piston ring is hard chrome plated, a design feature which greatly increases ring and liner life. Pistons are held within close weight limits. Connecting rods are machined on the outer sides of the shank for accurate, uniform weight and are carefully selected to close weight limits.

A new oil pressure control system assures a high oil pressure at the bearings when starting, even in extreme cold weather. A pressure control tube from the center main bearing to a plunger-type valve on the oil pump intake allows the oil pressure to be automatically regulated by the pressure actually within the main bearing. With this system, a high pressure, limited to 90 lbs. per sq. in. by a safety valve, is immediately available to push cold oil to the bearings. As soon as the flow to the bearing is established, the oil pump intake is automatically throttled and oil pressure is maintained thereafter at 30-35 lbs. per sq. in. This system is a marked improvement over the conventional pressure control valve which circulates the excess capacity of the pump under pressure into the sump of the oil pan.

The engine is equipped with new solid aluminum alloy main and connecting rod bearings. Being of one piece, the bearings avoid the hazards of bonding the bearing metal to a backing shell.

A new governor, accurate and quick acting, has anti-friction bearings throughout. The inertia of the moving parts is reduced by connecting the governor linkage directly to the fuel pump rack.

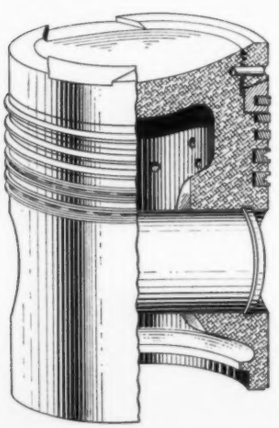




Far left, Individual fuel injection pump for D-311 Caterpillar Diesel. Cam-operated pump is controlled by gear linkage to engine governor.

Left, New Spring-loaded, pressure operated fuel injection valve with single orfice nozzle. Mechanism is calibrated at factory.

Below, Cutaway drawing of new piston —Composite construction includes aluminum alloy body with iron band for top ring groove.



Dr. Lucke Honored by A.S.M.E.

AT its sixty-eighth annual meeting, held in Atlantic City December 1-5, 1947, the American Society of Mechanical Engineers awarded to Dr. Charles E. Lucke a well-earned honorary scroll bearing the following citation:

* * *

The American Society of Mechanical Engineers, Oil and Gas Power Division, Honors Charles Edward Lucke, fellow, for his pioneering part in initiating the Professional Division idea, which has been so fruitful to the Society's growth and progress, and in founding the first of these now known as the Oil and Gas Power Division, which held its initial meeting February 11, 1908.

Signed—Eugene W. O'Brien, President, American Society of Mechanical Engineers; C. E. Davies, Secretary, American Society of Mechanical Engineers; Lee Schneitter, Chairman, Oil and Gas Power Division. Dated: Dec. 1, 1947.

* * *

Marine Industry on Parade

LATEST progress report of the Third National Marine Exposition which will be held under the sponsorship of The Propeller Club of the United States in Grand Central Palace, New York, the week of May 17-22, includes the names of many leading steamship and shipbuilding companies, manufacturers of electronic apparatus and marine equipment who will take advantage of this opportunity to demonstrate the part they are playing in the operation of the new American Merchant Marine.

In sponsoring the National Marine Exposition, The Propeller Club is rendering a valuable service to the industry in providing the medium by which manufacturers may display their products and others may demonstrate the services they are prepared to offer not only for the construction of ships but for the continued maintenance of a merchant fleet in keeping with the United States position among the world's maritime nations. The general public will be admitted to the Exposition free of charge between 2:00 P.M. and closing time each day during the week; prior to 2:00 o'clock admittance will be by invitation only.

The program for the week's activities is now being developed by the Propeller Club. Leading associations in the industry will be invited to participate, and a large space has been reserved which will be used as headquarters at the Exposition for these associations' members and guests.

Roger E. Montgomery, President and General Manager of National Marine Expositions, Inc., which is managing the Exposition has released a partial list of Exhibitors, totalling some 50, representing all phases of the marine industry.

Marine Diesel Standards Committees Meet

VALUABLE counsel and guidance was recently given to the editorial committee of engineers which is writing the book, "Marine Diesel Standard Practices." Those who gave the editors their constructive criticisms of the material thus far compiled, were seven members of the Society of Naval Architects and Marine Engineers. They were Charles MacPherson, senior engineer surveyor, Lloyds Register of Shipping; A. S. Thaeler, assistant chief engineer, Federal Shipbuilding & Dry Dock Co.; Jorgen S. Nielsen, Diesel engineer, Shipbuilding Division, Bethlehem Steel Co.; Hugo Haas, Diesel engine section, U. S. Navy, Bureau of Ships; Dwight Simpson, naval architect, John G. Alden; A. R. Gatewood, chief engineering surveyor, American Bureau of Shipping, and Eads Johnson, naval architect.

Left to right, rear row: C. MacPherson, J. G. Earle, E. L. Dahlund, H. T. Hill, J. L. Ostberg, A. S. Thaeler, F. K. Baldwin. Left to right, front row: J. S. Nielsen, D. Simpson, E. Frederick, Chairman, W. B. Moore, and H. Haas.

The editors are drawn from the membership of the Diesel Engine Manufacturers Association. They are Edmund Frederick, Chairman, assistant chief engineer, Cooper-Bessemer Corp.; John G. Earle, special representative, Nordberg Mfg. Co.; Ervin L. Dahlund, assistant director of engineering, Fairbanks, Morse & Co.; John L. Ostborg, chief designing engineer, National Supply Co.; Paul Shirley, consulting engineer, Hooven, Owens, Rentschler Div., Lima-Hamilton Corp.; Wesley B. Moore, Manager, marine engine division, Worthington Pump & Machinery Corp., and Roy A. Hundley, chief engineer, Enterprise Engine & Foundry Co.

At the New York meeting, held in the Waldorf Astoria Hotel, it was announced that the book would be off the press next March. The price is to be $5.00.

Bellows Appoints A. S. Terry Sales Manager

A. S. TERRY of Grand Haven, Michigan, has been appointed sales manager of The Bellows Company, Akron, Ohio, manufacturers of Bellows Air Motors and "Controlled-Air" Devices. The appointment was made by L. F. R. Bellows, President.

A. S. Terry

Mr. Terry was formerly head of the Detroit district office for Bellows.

New Catalog on Herringbone-Gear Reducers

MANY new sizes and types of enclosed herringbone gear units for speed reducing and speed increasing service, are detailed and described in a new Book No. 1819 of 68 pages, recently completed by Link-Belt Company and now available for distribution.

A copy of new Book No. 1819 will be forwarded promptly on receipt of request, which may be addressed to Link-Belt Company, 2045 W. Hunting Park Ave., Philadelphia 40, or other office of the company.

Recent and Future Developments In Diesel Engines

. . . . *Continued from page 63* . . . .

The first and basic reason for Diesel popularity is the extremely high efficiency and simplicity of the Diesel engine compared with other types of prime movers.

A second reason has been the improvement in the Diesel engine itself. Due to improvements in mechanical design and lubricating oil, high speeds resulting in lighter and cheaper engines became available.

Let us now look more carefully at the relative efficiencies of the Diesel and other types of prime movers. (See Figure 4). It is to be noted that compared to all, the Diesel is far and away the most efficient.

Fuel Costs and Supplies

It is important to note, however, that superior efficiency is not the sole determinant of fuel costs in operation. Another factor is certainly the cost of the fuel per unit. Thus, in some instances, coal is sufficiently economical so that almost irrespective of superior Diesel efficiency, the use of coal in the steam boiler gives lower fuel cost than a Diesel burning relatively high priced oil. The same effect holds true elsewhere, and it was and still is the lower cost per gallon of Diesel oil compared to gasoline that is an important factor in the use of many Diesel engines rather than gasoline engines. Because of the importance of fuel costs, many influential forces in this country have urged very strongly that lower grade, lower cost fuel oils be given greater emphasis for the Diesel engine.

The petroleum situation is of great significance to the Diesel engine, and Diesel oil costs have increased considerably in the last year. For petroleum technology has reached the stage where oil is not simply gasoline or Diesel oil or residual oil. We now can convert these oils as we see fit to suit market demand. Thus, whereas in the past Diesel oils had been considered the by-product of gasolines, it is now beginning to be considered a partner so far as end use is concerned, and its cost has been increased in accordance with its importance.

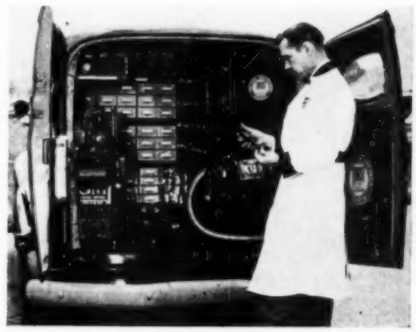
Recently, for security reasons, our government has been sufficiently concerned about the scarcity of petroleum to experiment with two new processes for obtaining new sources of soil. One of these is the process of obtaining oil from shale; in the state of Utah a pilot plant has successfully obtained petroleum oil from shale deposits which are enormous in extent. Although this probably means that costs will be slightly increased, it should not be very great and we are in any event assured of a continued oil supply.

A significant indication of how the Diesel industry has kept its eyes open is an outstanding new development—the combination gas-oil engine. With this engine we can burn natural gas on the Diesel cycle attaining the full efficiency of this cycle while using only a small amount of oil, 10% or less, for pilot ignition.

This development has become extremely popular within the last year throughout the Middle West where natural gas from Midcontinent oil fields is available, and in engines used in the oil fields themselves.

With the use of natural gas, the savings are actually enormous compared to fuel oil, and, in fact, can halve the fuel cost during the course of a year, when the fuel cost is perhaps 75% of direct operating cost.

Detroit Diesel Develops Mobile Service Units



G-M Service truck is equipped with necessary tools and parts for field repair work on Series 71 Diesel engines.

Electro-Motive Organization Changes

N. C. DEZENDORF, Director of Sales and Service, Electro-Motive Division of General Motors, recently announced the following organization changes.

R. L. Terrell

R. L. Terrell, formerly District Sales Manager at Washington, D. C., is appointed General Parts Manager with headquarters at La Grange, Ill.

W. D. Davis

W. D. Davis, formerly Parts Manager, is appointed to head a newly created Service Repair Department including five Branch Repair Shops, with headquarters at La Grange.

Christensen Heads Burmeister and Wain Subsidiary Corporation in U.S.

POUL A. CHRISTENSEN was recently named as President of the newly formed Burmeister & Wain American Corporation. The new corporation is a subsidiary of Burmeister & Wain, Ltd., of Copenhagen, Denmark. Christensen was formerly consultant for Burmeister and Wain. The address of the new corporation will be the same as that used by Mr. Christensen formerly—35 West 53rd St., New York 19, New York.

Moore Named by Crocker-Wheeler

P. J. Moore

CROCKER-WHEELER Electric Manufacturing Company of Ampere, N. J., a division of Joshua Hendy Corporation, has announced the appointment of Paul J. Moore to the newly created position of Director of Sales and Engineering.

Air-Maze Names Paullin

E. M. Paullin

THE Air-Maze Corporation recently announced the appointment of Edward M. Paullin as factory representative in charge of its Buffalo office, 28 Church Street. He will handle the firm's accounts in the State of New York with the exception of New York City, Long Island and Westchester County.

Auto-Lite Expands Diesel Equipment Facilities

DIESEL equipment for both trucks and special industrial units is being supplied in quantity by The Electric Auto-Lite Company, large independent manufacturer of automotive electrical equipment. In addition Auto-Lite also is manufacturing special Diesel equipment for locomotives and marine engines.

Keel Laid for "Harry Truman" Towboat

THE keel of the towboat for the Federal Barge Lines integrated tow *Harry Truman* was laid at Avondale Marine Ways, Inc., on the New Orleans River front recently. It was designed by Captain A. C. Ingersall, president of Federal Barge Lines. It is driven by two 1600 horsepower General Motors Diesel engines connected through a reduction gear to twin propellers. The equipment installed is of the latest design. Goldschmidt Contra-Guide Rudders were installed on River equipment for the first time. The propellers were designed by Professor Baier of the University of Michigan. The new integrated tow, designed to be operated as a unit, consists of two bow pieces, five barges, and the tow boat. Total length of the integral unit is 1200 feet. It is the latest word in river equipment. James H. Bull, president of Avondale stated that the towboat will be delivered some time in April, 1948.

Bailey Schools Has New Director

Lee C. Morris

IN line with expanding operations at The Bailey Technical Schools C. W. Bailey, President, recently announced the appointment of Lee C. Morris as Director of Education for the several schools. Morris is already serving in his new capacity at The Bailey Schools which are located at 1651 S. Grand Blvd., St. Louis.

Descriptive Dyson Folder

A 4-PAGE folder on Large Forged Nuts, starting at three inches and used for large construction and for heavy machinery and equipment, has recently been published. This bulletin describes the types of nuts fabricated, which include the standard varieties as well as the unusual types of nuts to blueprint, heat treated and machined as desired.

Available upon request from the manufacturer, Jos. Dyson & Sons, Inc., 5125 St. Clair Ave., Cleveland 14, Ohio.

New Ninth Edition of "Results Of Publicly-Owned Electric Systems"

THIS volume of about 400 pages gives a record of the new rates, earnings, production, consumers, operating expenses, free services, taxes paid and other operation statistics of over 600 cities of population 2500 and upward. The record shows Diesel, Steam and Hydro plants.

A free copy goes to every city owning its electric utility and where that city has furnished its rates and operating data. To all others the charge is $10.00 per copy prepaid. Orders now are being received by the Publishers, Burns & McDonnell Engineering Company, 95th and Troost, Box 7088, Kansas City, Missouri.

Order Your Copy of the 1947 DIESEL ENGINE CATALOG now. Thoroughly revised — more complete — indispensable. Convenient order coupon on Page 77 this issue. Mail it today.

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Cooper-Bessemer Corporation
Cummins Engine Company

Enterprise Engine & Foundry Company

Fairbanks, Morse & Co.
Fulton Iron Works Company

General Machinery Corp. (Hooven, Owens, Rentschler Division)
General Motors Corporation
Cleveland Diesel Engine Division
Detroit Diesel Engine Division
Electro Motive Division
Gray Marine Motor Company

Hallett Manufacturing Company
Joshua Hendy Iron Works
Hercules Motor Corporation
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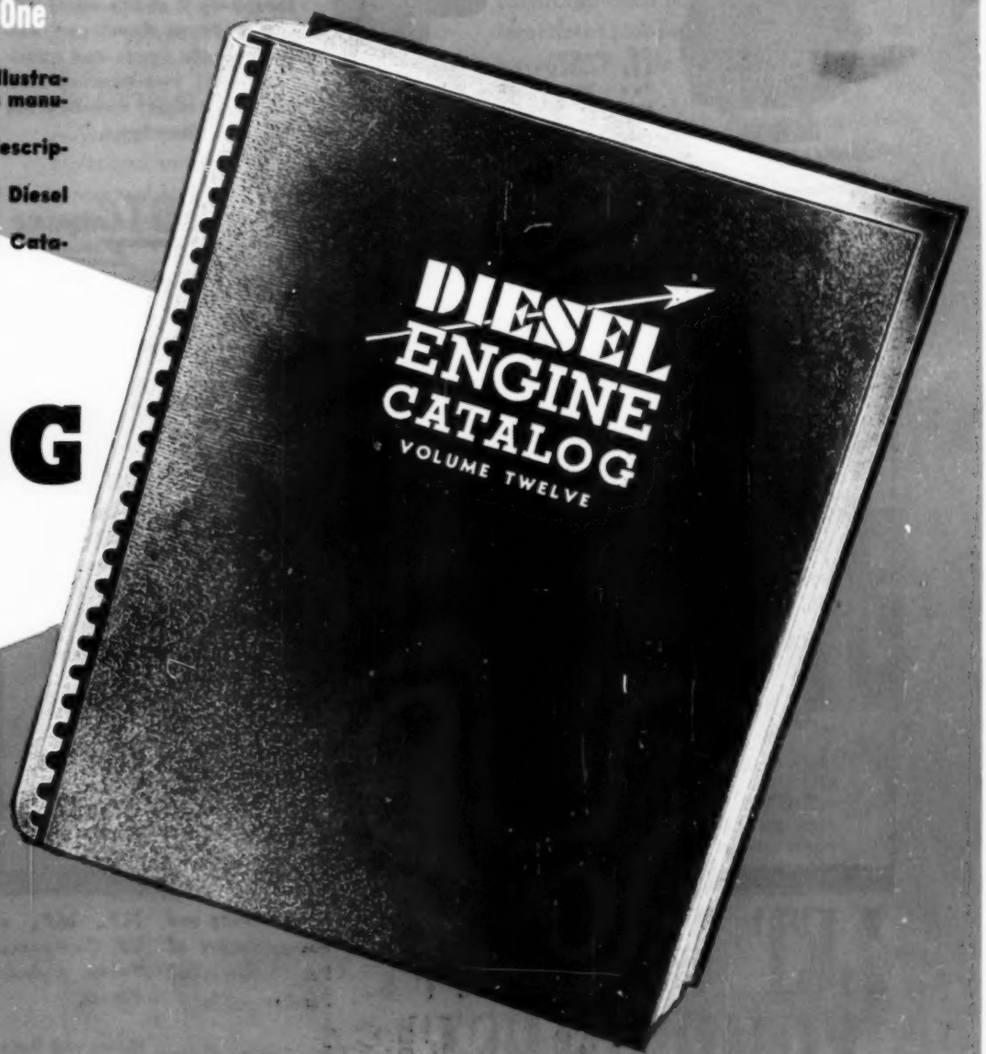

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New Korfund Rubber-Spring Mounting

Phantom view of Korfund vibration control unit

A NEW low-cost vibration control unit, the K fund Type RS Conical Rubber-Spring Mounti has been announced recently by The Korfu Co., Inc.

The new Korfund Type RS has been desig primarily for use on compressor units, genera sets, motor generators, pumps, motors, fans a other machinery requiring a highly efficient, e nomical, standardized vibration isolator. Ple write for further details and Korfund RS Bulle from The Korfund Co., Inc., 48-28 Thirty Seco Place, Long Island City 1, N. Y.

Diesel-Electric Crane

KEEPING pace with the railroads, which a now being revolutionized bp Diesel-electric pow American Hoist and Derrick Company has p fected a new Dieselectric locomotive crane.

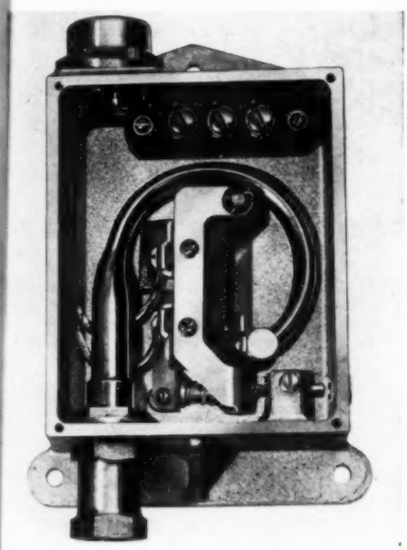
Cost and performance studies of this crane, cost ing extensive operation in many industries, ind cate it will earn back its original cost much fast than other type cranes, through greater work ou put and lower maintenance expense. Capacit 40 tons. A new catalog, now ready for mailin gives full details and specifications. Write Amer can Hoist and Derrick Company, St. Paul, Minn sota, for full particulars.

Friendship Train Spans Continent with Diesels

Union Pacific supplied a 6000 hp. Fairbanks-Morse Diesel locomotive for Friendship Train.

CONTRIBUTING their small share to the gigantic effort made by the American people for the relief of suffering abroad, Diesel locomotives hauled this cargo of foodstuffs across the continent to the eastern seaboard where it was transferred for shipment abroad.

Pressure Operated Switch



Meletron Model 310 pressure operated switch

MODEL 310 is one of Meletron's wide line of switches actuated by the pressure of liquids, air or gases. Its Diesel application is that of actuating warning devices or stopping operating equipment when operating pressures become too high.

Write the Meletron Corporation, 950 Highland Ave., Los Angeles 38, California, for further information.

Nordberg Appoints Sales Executives

ANNOUNCEMENT is made of the new sales executives in the Heavy Machinery Division of the Nordberg Mfg. Company. In the Heavy Engine Section of that division, L. L. Peterson has been appointed Sales Manager, while H. G. Van Schaack has been given the same position in the Gasoline Marine Engine Section.

NEW EQUIPMENT

TWO NEW heavy-duty hydraulic jacks, 30 ton and 50 ton models, have been announced by the Blackhawk Mfg. Co.

A NEW ELECTRIC hand tachometer by Metron Instrument Company features 1% accuracy over a 200 to 10,000 rpm. range. A slow speed model has ranges from 20 to 1000 rpm.

A PRECISION BORER is now being used by Diesel repair shops throughout the country for rocker arm boring operations. This Hydro-Borer is one of a series of precision boring tools designed to handle Diesel parts. Accuracy is to .001 in ± 0.

TWO NEW DRIVES announced recently by Twin Disc Clutch Company include a multiple engine hydraulic drive and a hydraulically actuated reverse and reduction gear. The first is suitable for Diesel engines developing 150 hp. at 600 rpm. to 325 hp. at 1500 rpm. The reverse gear can be utilized with engines developing up to 160 hp. at 1200-1800 rpm.

UP FROM FLORIDA comes the latest wrinkle in tractor attachments in the form of a root rake designed to clear land to a depth of 16 inches. It will be marketed by the Caterpillar Tractor Co.

A-C GENERATING systems for motor buses, a new development by Leece-Neville, have been adopted as standard equipment by two leading bus manufacturers. High output A-C current is dry-disc rectified.

HIGH TEMPERATURE, high pressure tubing by Titeflex incorporating Inconel is designed to withstand corrosive action of Diesel exhaust as well as the effects of continued vibration.

A NEW EXPANDER SPRING developed by the Sealed Power Corporation for use with oil rings is said to offer greater oil economy because of its open construction and flexibility.

A NEW LINE of expansion joints by Zallea Brothers & Johnson, capable of absorbing movement of high temperature lines in any direction is now under production. Joints are particularly adapted to Diesel exhaust and intake lines in stationary or shipboard installation.

U. S. GAUGE has developed a new absolute pressure gauge, dial reading in inches or millimeters of mercury. It is furnished in a black plastic case.

TO SIMPLIFY the repair of Diesels, Cummins Engine Company have introduced a line of 31 service parts kits, covering a great variety of engine replacement parts. A catalog describing these kits is available from the company.

THE TENDENCY towards full-flow filtration of Diesel lubricating oil is increased by the announce-

ment of Wm. W. Nugent & Co. that they have developed such a system for Diesel engines. A wastetype filter in series with an absorbent cellulose type (for fine filtration) insures the complete filtration of all crankcase oil on each circuit through the pump.

FALK CORPORATION describes its line of "Steel-flex" couplings in a new bulletin. The grid-groove design of the coupling permits a large amount of torsional resistance as well as flexibility.

A NEW FUEL ADDITIVE has been announced recently by the Industrial Chemical Corporation of Los Angeles. It is said to increase engine efficiency as well as save fuel.

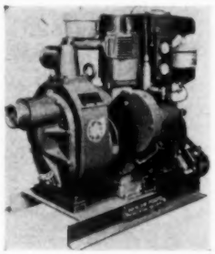
A NEW PRESSURE GAUGE utilizing nylon fibre will be introduced soon by Manning, Maxwell and Moore, Inc. The nylon movement of this new Ashcroft Dura-gauge is said to outlast other movements.

A PORTABLE HYDRAULIC unit capable of delivering 3 gpm. at 1000 psi. was recently announced by Hydro-Power, Inc.

A GEAR PULLER set manufactured by the Plomb Tool Company provides equipment needed for majority of pulling jobs. 42 piece set suitable for repair shops and industrial plants.

GENERAL ELECTRIC COMPANY announces a new metal alloy which has a density 50% greater than lead. Hevimet as the new alloy is called is adaptable for weighing and counterweighing rotating parts such as crankshafts, centrifugal clutches and other machinery.

R. H. SHEPPARD Company has developed a Diesel pumping unit suited for handling light petroleum products. Unit comprises a 3½ hp. Sheppard Diesel, single cylinder air-cooled and a 220 gpm., self-priming centrifugal pump. It is stated that unit will pump 36,500 gallons of water with a fuel expenditure of only one gallon.



INTERNATIONAL Harvester has announced the development of a new engine which is convertible in production as either a gasoline or Diesel engine. The announcement was made by H. T. Reishus, general manager of the company's Industrial Power Division. This new engine will meet the demand for a smaller, lower-priced Diesel.

The major feature of this new engine from a production standpoint, Mr. Reishus pointed out, is that it will enable the company to produce both gasoline and Diesel tractor and industrial engines on the same assembly line.

Names in the News

H. L. KNUDSEN retired recently as Vice-President in Charge of Engineering of Cummins Engine Co., after 25 years as a member of the company's Engineering Department. He continues as a Director of the company.

WILLIAM B. PROSSER was recently appointed General Manager of the Perfect Circle Corporation. Prosser joined Perfect Circle as plant manager in 1928. Since 1943 until his recent promotion he served as general factory manager.

D. O. THOMAS, President of Bendix-Westinghouse Automotive Air Brake Company, recently appointed Stephen Johnson, Jr. as Chief Engineer of the company. He will serve directly under E. R. Fitch, Director of Engineering.

DOUBLE SEAL RING has named R. W. Hoyt as Chief Engineer. Hoyt, formerly with Bendix Corporation, joined Double Seal Ring in 1946. He is a graduate of the Mechanical Engineering School of Purdue University.

J. H. GILL recently took over the job of Engine Sales Consultant for Caterpillar. He joined Caterpillar in 1937 after four years with Wm. C. Holt Machinery Co.

LINK BELT CUSTOMERS of Michigan will be glad to note that Peter Groustra will manage the New Link Belt Company office in Grand Rapids.

MACK TRUCK has announced the apopintment of H. J. Fikejs as Manager of the Mack Truck Company's Milwaukee Factory Branch.

SCINTILLA MAGNETO DIVISION of Bendix Aviation Corporation recently named George M. Anger as western states representative. Plans are under way to establish an office in San Francisco where he will maintain headquarters.

J. A. CORTRIGHT, general sales manager of the Clayton Manufacturing Company of El Monte, California, recently announced the appointment of A. G. Orsborn as his assistant in charge of Sales Promotion. Clayton specializes in Vehicle Analyzers and cleaning compounds.

L. H. BENSON has joined the Tuthill Pump Company as vice-president in charge of manufacturing. Benson, a mass production specialist, will aid considerably in the expansion plans of the company.

WEATHERHEAD COMPANY announces that T. G. Carey has been advanced to the position of purchasing agent of production parts and subcontracting.

LLOYD A. HARRIS, of National Supply Company, has been transferred from the Superior Engine Division to the Plant's Products Division. Harris has assumed his new duties in Houston, Texas which will include sales and service of Superior engines in the oil industry.

D. C. GRAHAM has been appointed by Nordberg Mfg. Company as sales engineer for the eastern territory. His headquarters will be in New York.

ATLAS IMPERIAL Engine Company has named John Seagren as chief engineer. Seagren recently resigned from the position as chief engineer of the Diesel Engine Division of the American Locomotive Company.

FEDERAL-MOGUL CORPORATION recently announced the appointment of M. R. Hunter as general manufacturing manager. Hunter will direct manufacturing operations in all of the company's plants. He will make his headquarters at the Corporation's main offices in Detroit.

ELLIOTT Company recently announced two new district managers. J. M. Maag is now Kansas City district manager. Mr. Maag was a field engineer in the Elliott Chicago office from 1925 until 1941, when he became St. Louis district manager.

J. M. Maag H. W. Honefenger

H. W. Honefenger who joined Elliott Company in 1936 as field engineer of the St. Louis office, has now been appointed St. Louis district manager succeeding Mr. Maag.

News Of The Industry

NEW YORK CENTRAL has placed orders for 111 Diesel locomotives including eight road passenger locomotives, 17 road freights, 15 transfer freights, 64 switchers, and 7 road switchers. They will be supplied by American Locomotive, Electro Motive, and Fairbanks-Morse.

SOCONY-VACUUM OIL COMPANY is rushing to completion a new barge with a capacity of nearly three-quarters of a million gallons which will aid materially in relieving the threatened oil shortage in the east. The barge is equipped with Diesel driven 1400 gpm. rotary pumps.

A NEW VISCOSIMETER by Fischer-Porter Company measures vicosity from .0008 to 800,000 centipoises according to a new bulletin issued by the company. Instantaneous reading of viscosity values in a moving fluid stream is possible with this new instrument. Write for Bulletin 88, Fischer Porter Co., Dept. 5E-H, Hatboro, Pennsylvania.

NATIONAL SUPPLY COMPANY has recently put in operation 2 heavy duty Wickes lathes. These lathes used for machining heavy crankshaft forgings are 45-feet long and weigh over 100,000 lbs.

NEW HAVEN RAILROAD will soon have its Bridgeport, Conn., yard completely Dieselized and will only use coal locomotives in emergencies. This is part of a program by the railroad to rid itself of the smoke nuisance.

GREAT NORTHERN RAILWAY announced recently that the acquisition of 9 new 4,500 hp. Diesel-electric locomotives during the past month has permitted the Dieselization of two trains running from St. Paul, Minnesota to Wenatchee, Washington. Great Northern now has 145 Diesel locomotives.

THE BALTIMORE AND OHIO railroad recently ordered 100 Diesel electric switching locomotives. The order for these 1000 hp. switchers is divided between Electro-Motive with 40; Baldwin Locomotive and American Locomotive with 25 each; and Fairbanks Morse and Co. with 10. Delivery is expected by the 3rd quarter of 1948 and will enable the road to completely Dieselize its terminals at Cincinnati, Youngstown, Warren and Pittsburgh.

700 MACK DIESEL BUSES have been ordered by Argentina. For operation in a region where gasoline sells for two and three times the price of Diesel fuel, Mack is powering all of these buses with a 165 hp. Mack Diesel engine. Paired with the Diesel is the new Mack torque converter designed to absorb the power of the engine at city driving speeds.

THE MILWAUKEE ROAD has ordered 38 new Diesel-electric locomotives at a cost of over $6,000,000. Included are eight 3000 hp. freight; six 2000 hp. passenger, twenty 1000 hp. switchers and four combination switching and road locomotives. Addition of the new fleet will bring the number of Diesel-electric locomotives on the Milwaukee road to 175.

THE SUPERIOR TUBE COMPANY has published an instructive bulletin describing its complete line of nickel and nickel alloy products, particularly its small tubing. Indexed for easy reference the bulletin describes the company's nickel, Monel, "K" Monel, Inconel, and 30% Cupronickel tubing which is claimed to have great strength, corrosion- and heat-resistance. Ease of fabrication is another claimed advantage. Write the Superior Tube Company, Norristown, Pennsylvania for Catalog section 10.

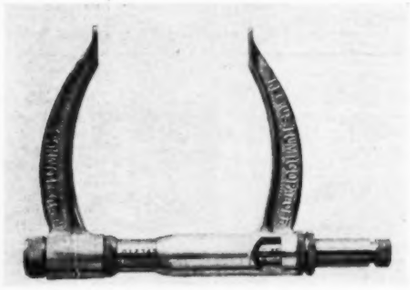
Merger of Automatic Temperature Control Companies Announced

THE Merger of Robertshaw Thermostat Company, of Youngwood, Pennsylvania, The Fulton Sylphon Company, of Knoxville, Tennessee, and the Bridgeport Thermostat Company, Inc., of Bridgeport, Conn., was announced recently by John A. Robertshaw, President of the new organization. J. V. Giesler, former President of the Fulton Sylphon Company and the Bridgeport Thermostat Company was elected Executive Vice President of the new firm in charge of the Fulton Sylphon and Bridgeport Divisions, while T. T. Arden was elected Executive Vice President in charge of the Grayson Controls Division, Lynwood, California.

Bradford Foote Dies

Bradford Foote Sr., founder and president of the Brad Foote Gear Works, died at his home recently after a short illness. Mr. Foote was born in Chicago on April 16, 1872. In 1924 he founded the company bearing his name.

New Tumico Micrometer



Tumico Crankshaft Micrometer

A NEW direct-reading crankshaft micrometer making it possible to measure journal diameters without removing the crankshaft from the engine block is announced by Tubular Micrometer Co.

Simple in design, this micrometer provides ample reach for all sizes of crankshafts. It is recommended for use on all types of crankshafts but is primarily designed for combustion engines. Tumico Crankshaft Micrometers insure measurements accurate to .001 in. (one thousandth inch). Capacity of the micrometer is from two to three inches in English calibration or 50 to 75 mm. in metric. For more information write Tubular Micrometer Co., St. James, Minnesota.

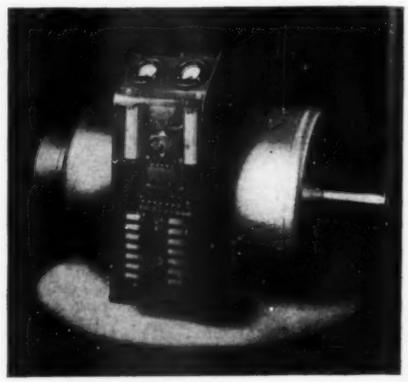
New Gauges Described

FIVE new gauges are illustrated and described in a series of new bulletins recently published by the F. W. Dwyer Manufacturing Company. The bulletins describe plastic tube manometers, hook gauges, air filter gauges, portable and stationary draft gauges. The last bulletin, No. 165, contains useful formulae concerning air flow data as applied to gauge readings. Write F. W. Dwyer Manufacturing Company, 317 South Western Avenue, Chicago 12, Illinois, for bulletins.

Engineering Society Meetings

THE Annual Meeting of the Society of Automotive Engineers will be held in Detroit, January 12-16. The Annual Meeting of the Oil and Gas Power Division of the A.S.M.E. wil be held May 20-22 in St. Louis, Missouri.

New Line of "Packaged" Generators



E-M generator with built-in voltage regulator

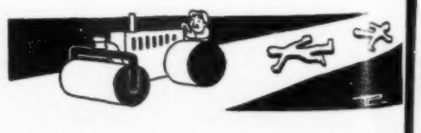
A "PACKAGED" generator recently announced by Electric Machinery Mfg. Company for use in engine-generator sets is a compact, factory-assembled unit including revolving-field generator, direct-connected exciter, automatic voltage regulating circuit, meters, and selector switch for presetting voltage.

Operation of the circuit is detailed in Publication No. 186 available from the manufacturer, Electric Machinery Mfg. Co., Minneapolis 13, Minnesota.

Portable Rock Crushing Plant

A NEW portable two-unit crushing and screening plant has been developed by the New Holland Manufacturing Company. This one-man push button controlled crushing unit on wheels has been fully field-tested with excellent results, according to the manufacturer.

Adaptable to either gravel crushing or quarry operations, a 200 hp. Murphy Diesel operates the 3030 Double Impeller Breaker while an electric generator driven from the same Diesel supplies power for driving the feeder, conveyers, screen and elevating wheel on the screening unit. Individual electric motor drives, controlled from the operator's platform on the crushing unit eliminates chains, sprockets and counter shafts.



WEST COAST DIESEL NEWS

By FRED M. BURT

REVIVING the tuna "mothership" idea, Van Camp Sea Food Co. has converted one of four A-N net tenders, purchased as Navy surplus; this 180 ft. A-N 53 has two 750 hp. American Locomotive Diesels hooked to a 1,500 hp. G.E. DC drive motor. Auxiliaries include two 60 kw. Buda generating plants and a 75 kw. "Caterpillar" set.

FROM the yards of Master Builders, Alameda, Calif., the 108 ft. purse seiner *Storm King,* built for Vincent Cardinalli of San Francisco, is powered with a 6 cyl. 840 hp. Union Diesel; auxiliaries, two "Caterpillar" 75 kw., 115 hp. Diesel generating sets.

POWERED with two 690 hp. Fairbanks-Morse Diesels, is the tug *Island Navigator,* owned by Island Tug and Barge Co., Victoria, B. C., to be used in deep sea service off the British Columbia coast.

FIFTY-FIVE ft. purse seiner, *New Sunrise,* owner Gordon Nelson, has recently had her original 140 hp. gasoline engine, installed when built by Grandy Boat Co., Seattle, in 1945, replaced by a 165 hp. General Motors Diesel.

WITH new dispensing and pumping facilities having a capacity of 36,000 gallons of Diesel fuel per hour, the newly-modernized Shell Oil Co. marine dock in San Diego Harbor, can fuel the largest tuna clipper in two to three hours. Ten 3 in. meters for Diesel fuel with two 2 in. nozzles apiece, seven meters and outlets for gasoline provide ample service. To prevent fuel shortage in the tuna season, a 5400 bbl. Diesel tank has been installed. E. R. Raphael is Southern California Division Manager.

OCEAN Tow, Inc., Seattle, newest tug and barge concern in the Puget Sound-Alaska run, to supply moving-power to their 21 260 ft. and 204 ft. barges, has eight, twin-screw, 126 ft. seagoing tugs, "Miki Miki" type, each powered with two 690 hp. Fairbanks-Morse Diesels.

THE APC No. 1, powered with a 400 hp. Superior Diesel engine, is being reconverted and readied for sea at yards of Anderson & Christofani, San Francisco, for Fulton Construction Co., Houston, Texas.

TROLLER *Bobetta,* building at Wrang Shipyard, Bellingham, for Henry Brandt, has 165 hp. General Motors Diesel with 3:1 hydraulic reverse and reduction gear also by GM. Supplied by Evans Engine and Equipment Co.

INDIAN Creek Industries Corp. recently purchased a Caterpillar Diesel to power a 550 gpm. two stage centrifugal pump at Weaverville used to raise water from river 500 feet to reservoir.

SEVENTY-FIVE kw. Caterpillar Diesel-electric set lifted itself aboard LST vessel recently when Diesel was operated at dockside with flexible leads to shipboard crane which lifted it aboard. Generating set was supplied to LST purchasers by Shepherd Diesel Marine of Los Angeles.

CANNERY tender *Hydah* repowered with 165 hp. General Motors Diesel. 4.38:1 Twin Disc reduction gear and Twin Disc frontpower take-off also installed by owners, Anacortes Canning Co. Supplied by Anacortes, Washington branch of Evans Engine and Equipment Co.

New Equipment for Piston Sizing

Wilkening Thermo-sizer

THERMO-sizing is a process now being used by Pedrick jobbers to reshape and resize alloy pistons so they fit exactly the cylinders in which they operate.

A machine called Thermo-sizer is used. It is the first machine to utilize "Heat-Shaping" in the reconditioning of pistons. By this process, worn and collapsed alloy pistons may be resized and reshaped as much as .030 in., safely and permanently.

Order Your Copy of the 1947 DIESEL ENGINE CATALOG now. Thoroughly revised — more complete — indispensable. Convenient order coupon on Page 77 this issue. Mail it today.

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